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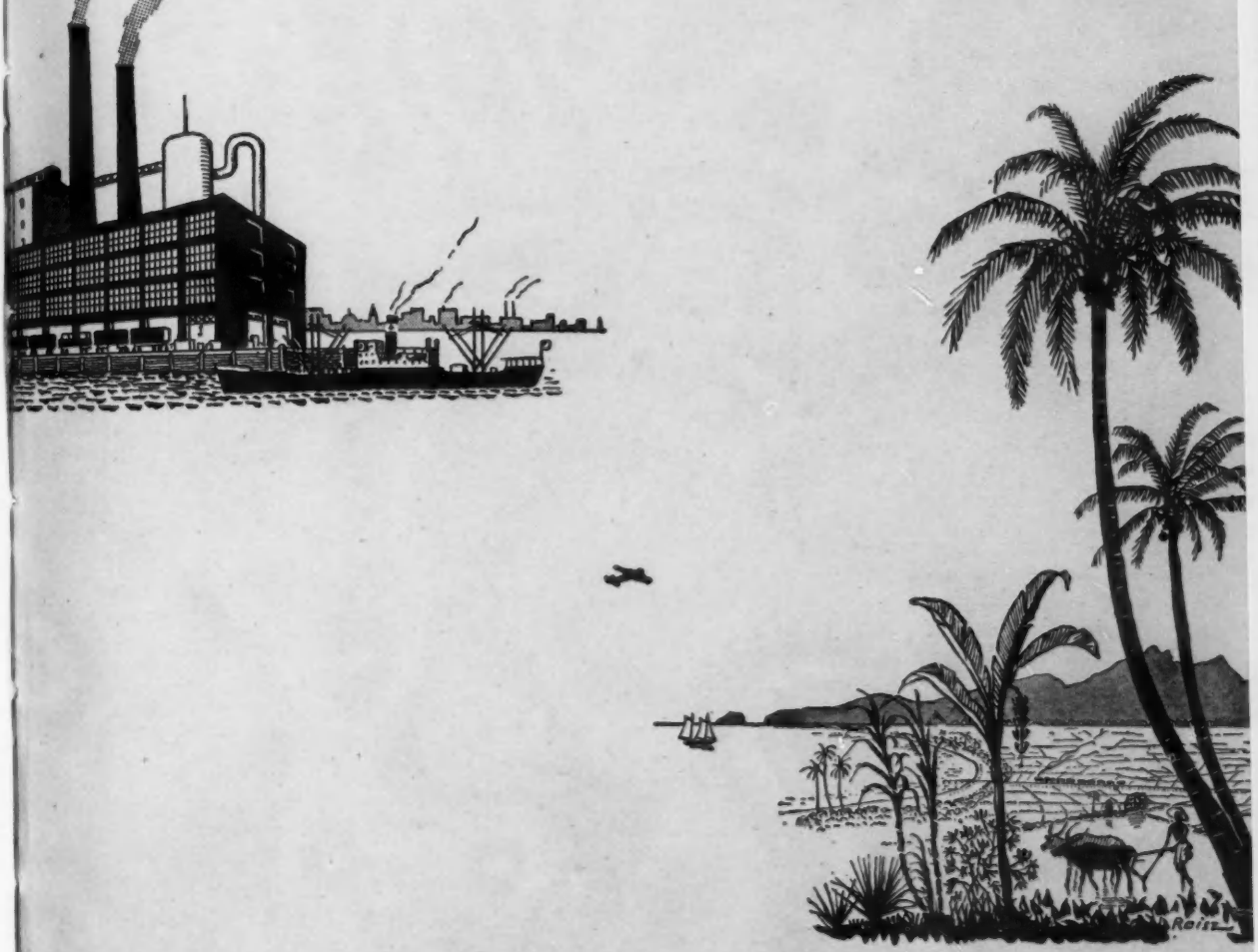

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ECONOMIC GEOGRAPHY
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ECONOMIC GEOGRAPHY

VOL. 27 JULY, 1951 NO. 3

RECENT QUANTITATIVE CHANGES IN THE COTTON REGIONS OF THE SOUTHEASTERN STATES

Merle Prunty, Jr.

Dr. Prunty of the University of Georgia was the author of "Soybeans in the Lower Mississippi Valley" in the October, 1950, issue of ECONOMIC GEOGRAPHY. *In the current study he has continued his research on the geography of the American South.*

THE land occupance conditions within which cotton is produced in the American southeastern states have changed greatly in the past quarter-century.* This discussion will be devoted to (1) quantitative changes in acreages and volumes in cotton production and their relative areal variations in the 1924–1944 period, and (2) distribution of the present principal cotton production areas, including their delineation. Evaluations of recent qualitative permutations in cotton production are excluded, as are also such associated features as regional variations in land management and operation procedures, mechanization, population migrations, and other cultural attributes in regional differentiation. Ultimately these and other features must be considered to achieve a comprehensive understanding of the geography of the Southeast, but they are beyond the scope of present consideration.

Historically, no other occupation has dominated the energies of the Southeast as has cotton production. Its economic, political, and cultural implications have been all-pervading. There still is little question of the dominance of cotton despite numerous recent changes in land occupance practices in the South, including introduction of new activities and expansion of existing ones. Many other occupations in the Southern states, such as banking, wholesaling, transportation, and retailing are indirectly influenced by the nature and scope of cotton culture, but few will dispute the reality of these influences despite their indirection. As a source of gross farm income cotton and cottonseed have dropped from about 45 per cent of the total for the region in the 1925–1929 period to about 25 per cent in the 1940–1944 period. Cotton provided about 30 per cent of the *cash* farm income of the South in the years 1940–1944, and this point is doubly significant since about 65 per cent of the population in the ten principal cotton producing states consists of rural residents. Cotton still is a cornerstone in the economic life of the Southeast and seems destined to retain a key position indefinitely.

The significance of cotton culture also is difficult to overestimate on the national level. Cotton is grown on about one-fourth of the nation's farms.

*Irrigated cotton production in California, Arizona, and New Mexico is not considered in this discussion.

A fifth of the nation's farm families depend directly upon cotton for at least some cash income. More than 12 million workers on farms, in factories, and in exchange and transportation industries are directly concerned with the crop. In recent decades about 60 per cent of the American cotton crop has been shipped abroad; as an export commodity cotton always ranked as one of the leaders in the years preceding World War II. For the past 17 years marketing and pricing of raw cotton has been subjected to legislation enacted by the Congress, and administered by a huge agency of the Federal Government which employs thousands of workers for this and related tasks.

Changes toward higher income levels and more effective land occupance practices have been keynotes to the Southern scene in the past quarter-century. New crops have been introduced, and yields derived from the older ones have increased substantially. Livestock and livestock products today are far more important throughout the Southeast than at any time in history. Burgeoning forest industries have fired the imagination of land owners on a wide scale; today, thousands of farmers are adopting sustained-yield practices to produce pulpwood and timber on an annual crop basis. Farm mechanization has proceeded by leaps and bounds; tractors on farms throughout the South increased about 82 per cent between 1939 and 1944 and in some states even more than doubled.[1] Farm management practices have improved remarkably, especially in regard to soil erosion control and use of fertilizers. Farm tenancy and sharecropping have declined while the average size of the Southern farm—heretofore small—has increased. Total per capita incomes for most of the South do not yet rival national averages but during the period 1933 to 1946 underwent a *percentage* increase about 50 per cent greater than did the average for the rest of the nation.[2] The land occupance scene in the Southeast has been one of turmoil; a minor revolution has been underway. And cotton culture also has undergone marked changes and shifts for it is, after all, integral within the Southern landscape. The old "Cotton Belt" is not what it used to be.

THE BASES FOR COMPARISON

The methods used herein are comparative on a gross basis via cartographic devices. Comparisons are drawn between the cotton crop acreages and yields for the years 1924 and 1944. Data are derived from the 1925 and 1945 Censuses of Agriculture throughout unless otherwise noted. Certain advantages accrue from the use of 1945 census data as noted subsequently, and the 1925 agriculture census provided the basis for O. E. Baker's evaluation of the Cotton Belt which until very recently has served as a cornerstone in regional land use delimitation for the Southeast. Comparisons based on two crop years without detailed consideration of the intervening years cannot supply a complete picture of the trends in changing land occupance procedures. Individual factors influence the distribution and volume of any agricultural product during a given year but may not be of significance during other periods. However, the *major* shifts and changes in production volumes can be interpreted with accuracy from statistics for two years alone provided there exists a reasonable basis for comparison between the two periods selected.

The Censuses of 1925 and 1945 provide somewhat more valid bases for comparisons than do the figures for any other recent years. The 1944 cotton crop, reported in the 1945 census,

is the only one for a census year since 1930 which was not controlled both in size and distribution by acreage quotas under the Agricultural Adjustment Acts. Although wartime conditions prevailed in 1944, cotton production figures for that year probably will be used for a long time to come as more accurately representative of "uncontrolled" production and marketing conditions than figures for other recent years. Since the 1924 crop was uncontrolled, it seems reasonable to assume that any comparisons with that year based on a controlled yield would be less valid than those resulting from comparison with another uncontrolled year. Both 1924 and 1944 were somewhat abnormal crop years, but for different reasons. In 1924 farmers in the South Atlantic seaboard states still were combatting the invasion of the boll weevil. Crop yields were relatively low as a consequence. In 1944 the volume of cotton produced was limited principally by World War II labor shortages. Thus limitations on volumes produced were experienced in both crop years, but not as a consequence of arbitrary or governmental controls. The average market price for middling cottons on the farm in 1924 was about 22 cents per pound, which was within 10 per cent, or less, of 1944 prices throughout that crop year.[3] The 1944 price averaged slightly above 20 cents per pound at the farm level. In terms of real values as indicated by wholesale commodity price indices, the 1924 and 1944 prices for cotton were virtually identical.[4] Cotton prices of 1944 were always above the "parity" level; while price parity was in force during the war years only rarely were cotton prices directly affected by it, as consequence of extensive demand. Therefore, from a price as well as a volume viewpoint the 1944 cotton crop was produced under what was in effect an uncontrolled market, and its comparability to 1924 conditions is felt to be superior to that of other recent years for these reasons.

Attempts probably will be made to interpret changes in land occupance practices in the Southeast via comparative evaluations using the 1950 Census as soon as these data are available. Any such efforts should be tempered with a great deal of caution where cotton production is concerned because of unusual production conditions which prevailed during the 1949 crop year. Cotton producers recognized in 1948 that surpluses of cotton were increasing again, as before World War II, and that the Department of Agriculture would institute some form of acreage controls before the 1950 crop was planted. Parity price supports in 1946, 1947, 1948, and 1949 were relatively high in comparison with prices for many other products of Southern farms. Most farmers believed that the 1949 acreages would be used as a basis for determining their acreage allotments when controls were restored and so planted as large an acreage to cotton as they possibly could; through this maneuver they hoped to obtain larger acreage allotments under quotas as well as large 1949 cash incomes. The result was one of the largest cotton crops in recent years, on a very large acreage, with somewhat lower per-acre yields than were characteristic in the war years. Thousands of acres were planted in every segment of the South with no hope or expectation of harvesting them completely. Many fields were picked only once. In January, 1950, open cotton on the stalks could be seen in field after field in every large cotton production district in the South. Unless some device is utilized which compensates for these conditions, studies utilizing 1950 Census data for

cotton (reporting the 1949 crop year) will be subject to serious question.

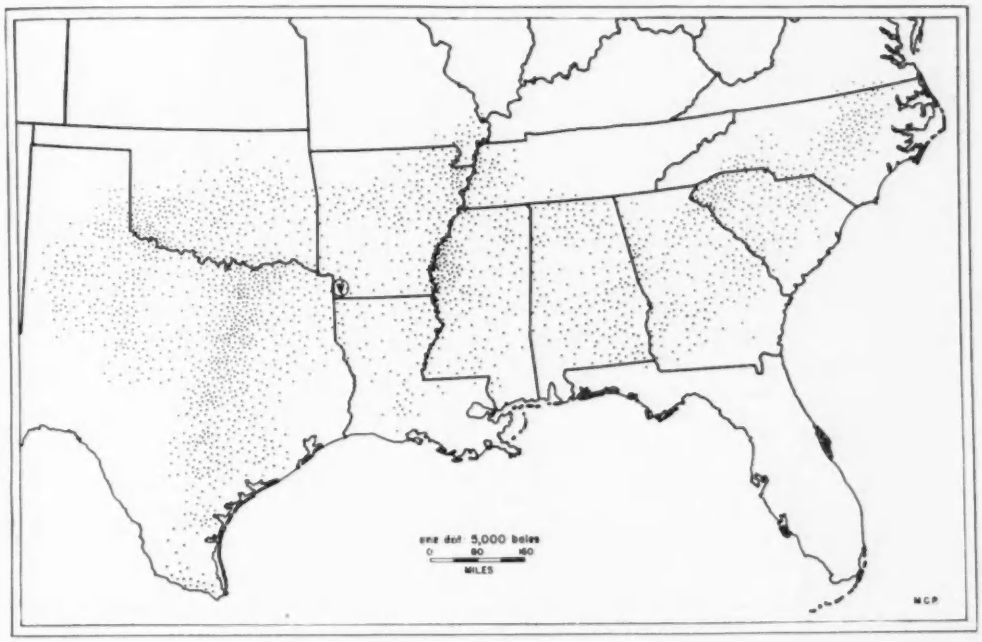
THE COTTON BELT IN 1924

In nineteen hundred twenty-four, 35,895,000 acres were planted to cotton in the United States. Of this amount only about 300,000 acres were in the irrigated districts of California, Arizona, and New Mexico, and only slightly more than 2 per cent of the total crop was produced under irrigation. Cotton culture was scattered from western Texas to southeastern Virginia, the traditional "Cotton Belt" of the United States Southeast. However, production was by no means evenly distributed. Nine regions stood out as primary production areas in 1924 (Fig. 1): These were (1) the central Piedmont in Georgia and the Carolinas, (2) the inner coastal plain in the Carolinas, Georgia, and southeastern Alabama, (3) the central Alabama "Black Belt," (4) the middle Tennessee valley in northern Alabama, (5) the Mississippi alluvial valley from southeastern Missouri to east central Louisiana, (6) the Arkansas River valley in Oklahoma and Arkansas, (7) the Red River valley from western Oklahoma to western Louisiana, (8) the Black Waxy prairies of eastern Texas, and (9) the Southern high plains of western Texas. Production and acreages harvested were greater in the Texas Black Waxy prairies than they were in any other leading production district (Figs. 1 and 2).

Productivity of cotton in 1924 was lower than has been the case in recent years, an average of 151 pounds of lint per acre (Fig. 3). The larger production areas in Texas were relatively light per-acre producers. Although the Mississippi valley ranked above the regional average in many sectors, the older cotton districts of the Georgia–Carolina Piedmont and the North Carolina inner coastal plain were uniformly the highest in per-acre productivity. The Canadian and Red River sector of the western high plains district also was a surprisingly high per-acre producer. Considering the Southeast as a whole productivity was fairly uniform in 1924. To some extent the low productivity factor on the South Atlantic coastal plains can be attributed to boll weevil infestations. The high yield factors for the Piedmont, however, also are indicated in more recent data for this district and suggest that soil production capacity may not have declined to the destructive levels ascribed to the area by several recent publications.

In 1927 O. E. Baker published his delimitation of the agricultural regions of the South, including the Cotton Belt.[5] This famous study was based on the 1925 census, and has served as a landmark in regional geography of the South for two decades. Baker's "Cotton Belt" was much like that of tradition in its areal extent, and has appeared in numerous geographical publications, atlases, government publications, and agricultural and economics studies.

Baker's delimitation of the Cotton Belt was based primarily upon the distribution of cotton production as indicated in Figures 1 and 2. In his article, Baker states that the Cotton Belt of 1924 was limited by growing season and topographic conditions along its northern boundary and by certain rainfall, soils, and moisture conditions along other boundaries. He did not explain how these features can be rationalized into a technique which will produce a boundary on a map. In private conversations with the writer about three years ago Dr. Baker stated that he affixed the boundary of the Cotton Belt simply by drawing a line about the outer limit of cotton produc-



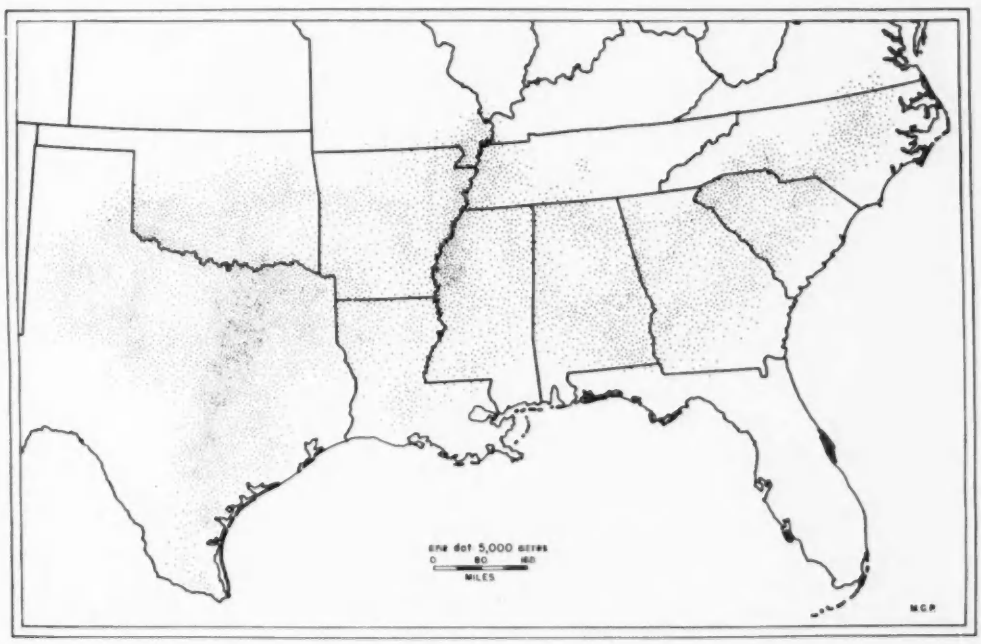


FIG. 1. Cotton harvested, bales, 1924, U. S. Southeast. Based on county unit data from U. S. Census of Agriculture, 1925. Circled triangle indicates position of median center of cotton production by volume in 1924. The 1924 center was located in west central Miller County, Arkansas. Computation of the position of the median center involved the Southeast only; the western irrigated districts were excluded. (See note under Fig. 9.)

FIG. 2. Cotton acreage harvested, 1924, U. S. Southeast. Based on county unit data from U. S. Census of Agriculture, 1925.

tion on a dot map similar to Figure 2. After the line had been drawn he looked for correspondence between it and any feature or features which could explain its position. Baker went no further than physical features in his search for relationships, and to these he ascribed an aura of causative value that correspondence in position, or coincidence, alone can rarely justify. In any event, delimitation of regions of cotton culture based only on the outer margin of cotton production is subject to criticism. Competition exists between cotton and other forms of land use in the Southeast just as it does among cultivated plants in most other areas, and cotton's proportionate position in relation to other types of land occupance normally is weakest at the periphery of the belt.

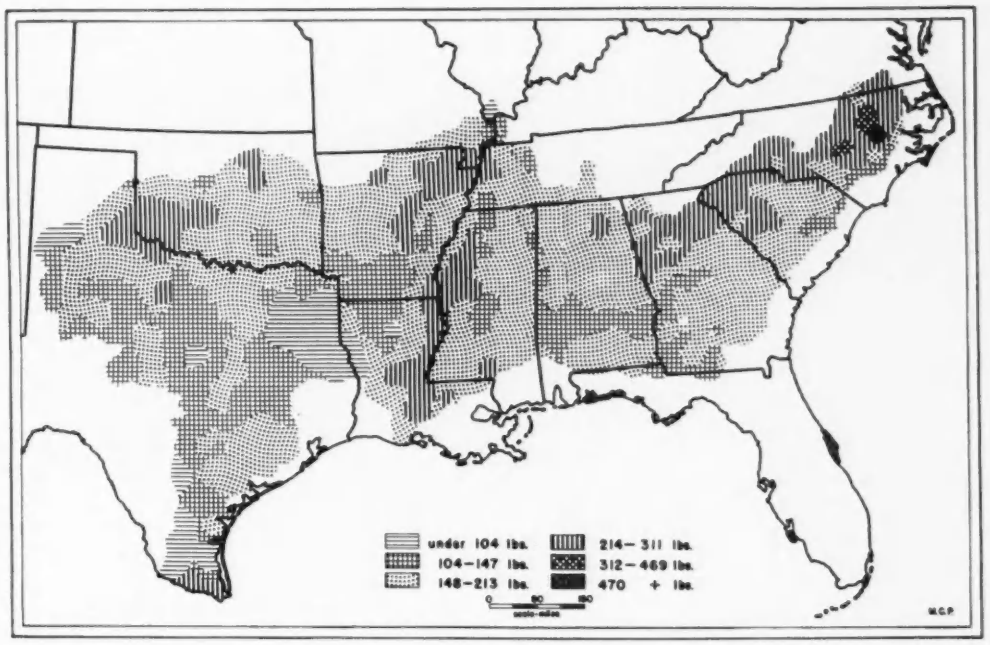
Since 1927 several localized studies made by geographers have appeared; these have tacitly accepted the delimitation of the Cotton Belt as set forth by Baker.[6]

Dr. Baker pointed out that many other crops were grown in association with cotton in most of the "Cotton Belt"; the *relative* position of other products to cotton was not exactly stated, however. Actually the "Cotton Belt" of 1924 involved a number of enclaves which did not produce sufficient cotton to justify their classification as cotton areas. These areas include central Alabama, the Ouachitas, north central Louisiana, and other smaller districts (Figs. 1 and 2). These segments not only are not "Cotton Belt" areas today; they never were and never should have been so considered. The widespread conception of the "Cotton Belt" as a virtually continuous area from southern Virginia to western Texas was partially erroneous in 1924 and has become more so in the intervening 25 years.

QUANTITATIVE CHANGES SINCE 1924

Acreages planted to cotton in the Southeast since 1924 have decreased markedly and steadily except in the 1925–1929 period (Fig. 4). In 1939 cotton acreage harvested totalled only 23,800,000 acres, and by 1944 the acreage had declined to 19,651,000 acres. The gross decrease between 1924 and 1944 for the nation as a whole constituted approximately 16,244,000 acres, or a decline of about 45 per cent. During the same period acreages planted to cotton in the western irrigated districts increased more than 90 per cent; the relative acreage decrease since 1924 in the Southeast has been more nearly 48 per cent.

As a consequence of these acreage decreases certain of the old large producing districts have lost their identity. The Arkansas valley in Oklahoma and western Arkansas, the coastal plains in southwestern Georgia and southeastern Alabama, the middle and upper Red River valley, and the Alabama "Black Belt" have virtually disappeared as major regions from an acreage viewpoint (Fig. 4). Comparison of acreage decreases with production decreases confirms their decline (Fig. 4 and 6). As early as 1941 Gibson indicated that the "Black Belt is no longer one of the South's important cotton regions," and attributed the declining significance of the crop to slow spring growth on calcareous soils, severe boll weevil ravages, unstable markets, an exodus of Negro laborers, and an expanding beef cattle industry.[7] More recently Tower has shown that the "Black Belt" has suffered a decline in cotton plantings ranging as high as 80 per cent of the 1909–1910 acreages, and that the remaining small acreages are situated principally on the noncalcareous soils at the fringes of the belt.[8] In the



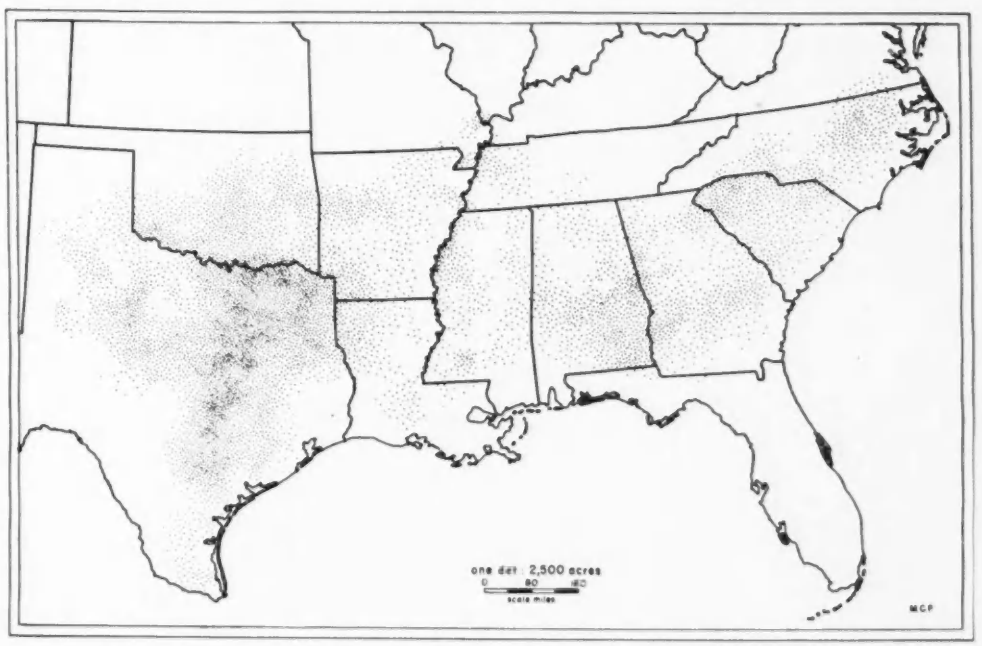


FIG. 3. Cotton lint produced per acre, 1924, U. S. Southeast. Based on county unit data from U. S. Census of Agriculture, 1925. The outer limit of cotton culture as indicated by this map was derived from the outer limit of dots representing cotton acreages harvested as indicated by Figure 2, and has no further significance.

FIG. 4. Decrease in cotton acreage harvested, 1924–1944, U. S. Southeast. Based on county unit data from U. S. Censuses of Agriculture, 1925 and 1945.

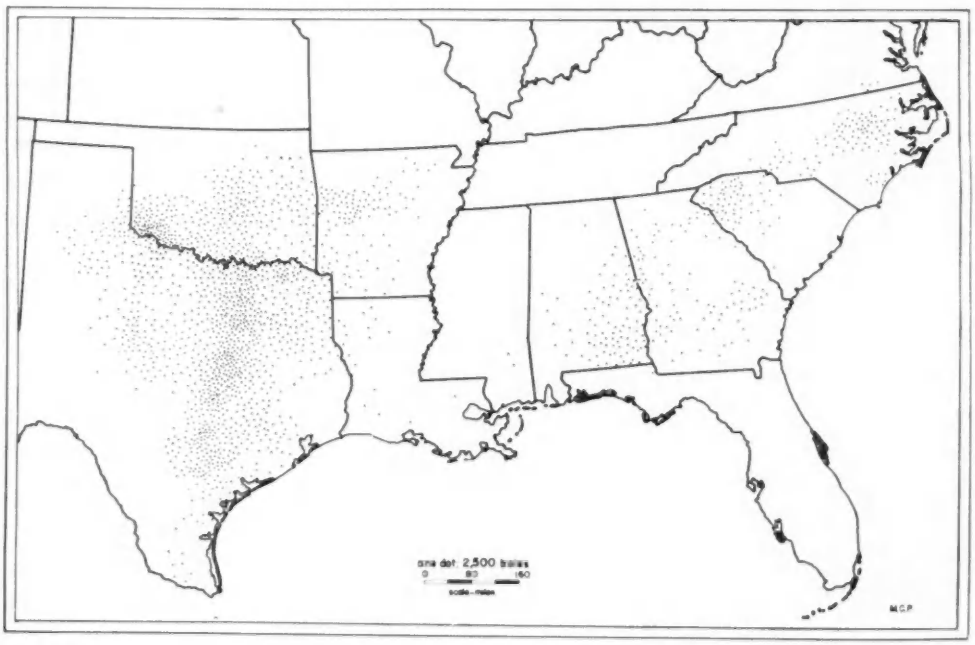


FIG. 5. Increase in cotton acreage harvested, 1924–1944, U. S. Southeast. Based on county unit data from U. S. Censuses of Agriculture, 1925 and 1945.

FIG. 6. Decrease in cotton bales produced, 1924–1944, U. S. Southeast. Based on county unit data from U. S. Censuses of Agriculture, 1925 and 1945.

Alabama coastal plains production is now somewhat less than half of the 1910–1925 average output.[9] Peanuts have displaced cotton as a primary cash crop in the old cotton regions of southwestern Georgia and southeastern Alabama.[10]

The remaining cotton districts have undergone shrinkages in gross acreages and also some reduction in the circumference of each district since 1924 (Fig. 4). The only large acreage increments (about 65 per cent of the regional total) have been added to the western perimeter of the Texas high plains district; however, decreases along the eastern margin of this area were somewhat larger than increments and the result has been a small net decline in plantings (Fig. 5).

By 1944 the high plains in western Texas were more highly mechanized for cotton production than any other segment of the South. Labor shortages engendered by wartime conditions were of much smaller consequence in this sector than elsewhere, and undoubtedly contributed to its acreage stability. Langsford has shown, for example, that the total number of man-hours necessary to produce and market an acre of cotton on the high plains averages about 22.6 hours if the crop is "snapped" by hand, and less than seven hours if mechanically harvested with a two-row stripper. Both figures—especially the latter—are much lower than the lowest man-hours average, using mechanical harvesters, in the other large cotton growing areas of the Southeast.[11]

The most striking acreage declines were those in the eastern Texas prairies. Large and relatively uniform decreases took place in the Piedmont and the inner coastal plains in the Carolinas and Georgia. The middle Tennessee valley has experienced proportionately less decline in acreages than other districts east of the Mississippi and today ranks with the other eastern areas as a primary production region (Fig. 4).

The factors underlying the marked declines in cotton acreages harvested in the Southeast vary in proportionate significance from one principal district to another, and not all of the underlying reasons apply in every district. An inherent difficulty in reaching over-all conclusions in regard to any phase of cotton culture is the wide variation in the conditions under which the crop is produced. Physical conditions, labor supply, cotton varieties, marketing conditions, farm organization, customs, and traditions differ from one area to another. In some instances the contrasts in production conditions within a leading district are as great as between the dominant attributes of two of the large cotton areas themselves. Despite these difficulties, certain fundamental events appear to apply in most cases.

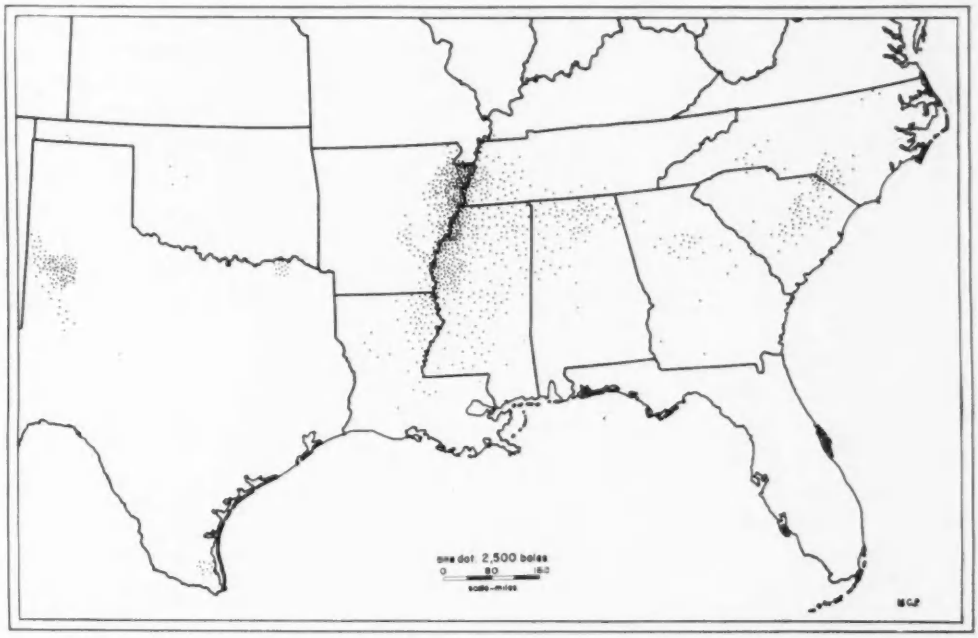
First of these was the *boll weevil* invasion. The weevil increased the difficulty of producing cotton and, in a negative way, induced the production of feed and forage crops while stimulating interest in new cash sources. The "boll weevil depression" of the early and mid-twenties was followed by the *economic depression of the early 1930's* during which period cotton prices were so low that the return from the crop scarcely justified its production. Once again Southern farmers placed renewed emphasis upon food and feed crops. The first *cotton acreage limitation* program began in 1933 under the Agricultural Adjustment Act, and governmental acreage and price controls lasted until after the inception of World War II. Another influential feature has been the *incentive payments program* of the Soil Conservation Service whereby farmers were subsidized when installing approved land use procedures; these

usually involve application of fertilizers, planting of leguminous forage or green manure crops, and introduction of pastures and hay crops. Partially as a consequence of the combined impact of the four foregoing factors and partially as a result of forceful on-the-farm educational programs and research promoted by the extension services and colleges, farmers throughout the Southeast have adopted a variety of *new field and forage crops*. Livestock industries have received attention never before accorded them on a regional basis in the South's history. Many operators are finding the new enterprises more profitable than cotton production in those districts where labor is in short supply. Finally, *World War II* created labor shortages where there had been none before, thus forcing farmers to make more effective use of their labor supply. When acreage limitations on cotton were removed early in the war many cotton farmers had large investments in other forms of land use which made an immediate return to cotton culture impracticable. In those districts where labor had been in short supply there was little desire to return to cotton growing anyhow, for wartime prices on all farm commodities were high and other types of land use were proving more profitable. Only those regions in which mechanization was fairly advanced could shift into expanded cotton production easily.

Although acreages harvested decreased greatly throughout the Southeast between 1924 and 1944, the volume of cotton produced *increased*. Tower has noted that, in Alabama, acreages in cotton declined over 63 per cent while declining only 14.4 per cent in volume produced between 1910 and 1944.[12] Production in 1924 totalled 11,515,000 bales; the 1944 crop for the entire nation amounted to 12,230,000 bales. The output in the western irrigated districts increased about 400,000 bales in the 20-year interval; the balance of the increase—some 315,000 bales—came from the Southeast. The greatest shift in distribution was the decline in output on the Texas Black Waxy prairies and the relative and absolute increase in the significance of the Mississippi valley (Figs. 6 and 7). Only in a few isolated instances did acreage increases accompany volume increases in the Mississippi valley; its increased output is nearly entirely the result of increased productivity.

The declines in cotton volumes (Fig. 6) have not uniformly followed reductions in acreages (Fig. 4). Although there was a crude correspondence in acreage and production decreases on the eastern Texas prairies, production changes were proportionately less in the old cotton districts of the Piedmont and Carolina inner coastal plains than were acreage declines in these areas. The net production gains in western Tennessee, northeastern Mississippi, northern Alabama, and on the North–South Carolina border are noteworthy also (Fig. 7).[13] The Carolina area's greater output is somewhat surprising since it experienced marked acreage decreases between 1924 and 1944.

In two sectors volume and acreage increases coincided. These were the central Piedmont in Georgia—with a modest increase of about 50,000 bales—and the western high plains in Texas (Figs. 5 and 7). The acreage increases in the latter area previously were noted and their relation to wartime conditions and mechanization mentioned. Although the mechanized nature of production in the high plains undoubtedly was a contributory factor, increased supplies of available water were equally important. The growing season in 1944 was somewhat more humid than



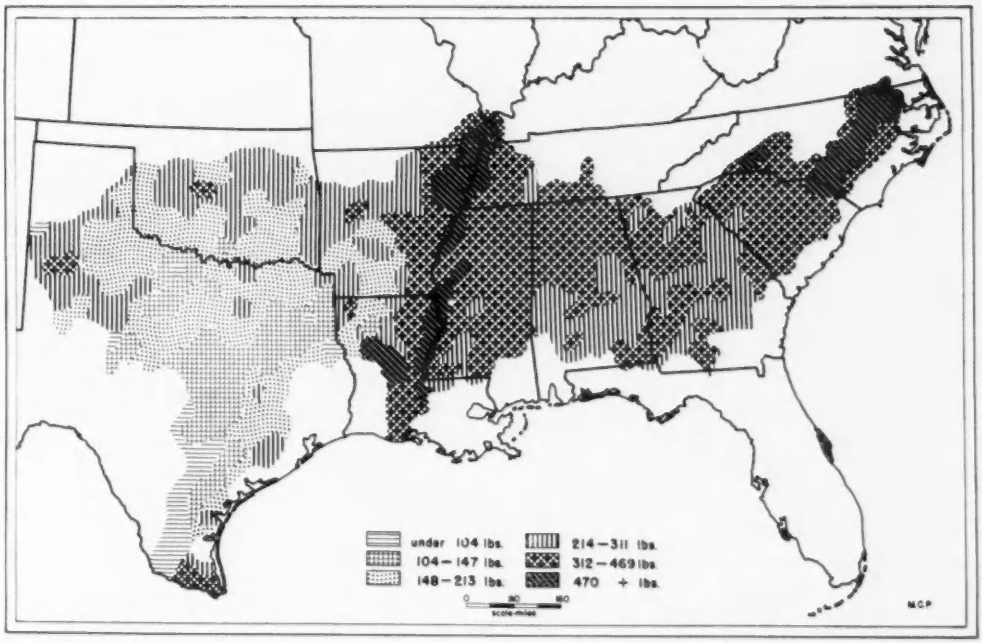


FIG. 7. Increase in cotton bales produced, 1924–1944, U. S. Southeast. Based on county unit data from U. S. Censuses of Agriculture, 1925 and 1945.

FIG. 8. Cotton lint produced per acre, 1944, U. S. Southeast. Compiled from county unit data from U. S. Census of Agriculture, 1945. The outer limit of cotton culture as indicated by this map was derived from the outer limit of dots, representing cotton acreages harvested, on Figure 10 and has no further significance.

is normal for this area. Also shallow-well irrigation has made great strides on the high plains in recent years. Gibson has previously indicated the values of well irrigation on the high plains.[14]

Changes in per-acre productivity since 1924 have been as extensive and are as remarkable as the declines in acreages harvested. Increased per-acre productivity, especially *east* of the Mississippi River, is the principal factor responsible for slightly greater production in 1944 on 48 per cent less cropland than in 1924 (Fig. 8).

Per-acre production of lint in 1944 averaged 299 pounds. The heaviest producing area on a per-acre basis was the Mississippi valley, with the leading unit-volume production districts well toward the northern margin of that sector. In 1944, sixteen counties in the "tri-state" district of southeastern Missouri, northeastern Arkansas, and western Tennessee averaged production above 500 pounds, which is equivalent to more than one bale (gross weight) per acre (Fig. 8). Mississippi County, Missouri, achieved the remarkable average of 630 pounds lint per acre, and this was not a case of "fringe" production on a small acreage. Mississippi County is a large one and cotton was planted to more than 30 per cent of its harvested cropland in 1944. Insofar as is known, the tri-state district of the upper alluvial Mississippi valley is the heaviest per-acre producer of non-irrigated cotton in the world today, as well as being a leader in long-staple non-irrigated output. The inner coastal plain in North Carolina has retained its important position in per-acre output although its total volume does not rival that of the Mississippi valley (Fig. 8).

All of the older eastern cotton districts have experienced heavy increases in per-acre output since 1924 (Figs. 3 and 8). Perhaps the most significant feature of Figure 8 is the uniformly high productivity achieved by all of the cotton areas east of the Mississippi. Somewhat surprising is the high per-acre production achieved in the western Texas high plains: the Black Waxy prairies do not rival their western neighbor despite greater mean rainfall and a larger labor supply (Fig. 8)!

Several features emphasized by Figure 8 are at variance with widely held impressions concerning cotton productivity in the Southeast: (1) the Yazoo-Mississippi "delta" is not as great a per-acre producer as segments of North Carolina, central Louisiana, and the tri-state district of the upper Mississippi valley; (2) per-acre production is highly uniform throughout the state of Mississippi—in other words, northeast Mississippi is a large per-acre producer on a small acreage; (3) production on the Texas high plains is much greater per acre than it is commonly believed to be; and (4) the old cotton districts east of the Mississippi, including Georgia–Carolina Piedmont and inner coastal plain, rank extremely well in per-acre yields and have achieved substantial production increases since 1924. These areas stood high in per-acre output in 1924 as has been noted previously. It is therefore valid, on the basis of the actual output of cotton, to question assertions to the effect that the soils of the Piedmont and inner coastal plain are exhausted, depleted, eroded, worn out, that ignorance prevails throughout the population, that land abandonment and poverty are necessary corollaries to land occupance in these areas. Insofar as cotton is concerned the production record does not correspond to such assertions.[15]

A number of features have contributed to the remarkable productivity increases in the Southeast in the past quarter-

century. In part all these features stem from the factors previously noted which underlie acreage declines. (1) As acreages have declined, each farmer has shifted his high unit-value crop (cotton) to his more productive land. (2) Increases in mechanization have meant better cultivation, more frequent cultivation, and more cultivation per-cotton-acre as a result of smaller total plantings per farm.[16] (3) Between 1929 and 1944 the application of lime to southern farms increased 840 per cent, and the purchase of commercial fertilizers increased 33 per cent.[17] It appears that more fertilizers were applied to the cotton crop and since it has occupied a smaller acreage, applications per acre have been far greater in recent years than formerly. (4) Boll weevil control has been more effective since smaller acreages are more frequently treated with poisons and since spray and dusting equipment have been developed for use with tractors. Better poisons have come on the market. (5) Decreases in cotton plantings have freed a greater proportion of cropland for rotation, usually resulting in greater per-farm acreage in leguminous and forage crops plus a longer rotational period for soil improvement crops per field in the total rotational plan. The consequence is improved basic soil production capacity. (6) To a large extent the loss of high-yield varieties of late maturing cottons which resulted from the boll weevil invasion has been overcome by the development of new varieties. These varieties for the most part mature early and thus escape severe weevil inroads near the end of the growing season. Specialized and improved varieties fitted to local conditions are available in every sector of the South today. (7) Particularly after acreages were severely restricted, many farmers abandoned the standard 42-inch spacing of cotton rows and used spacings of 36 and occasionally even 32 inches. Obviously many more plants were grown per acre. (8) Net lint losses through ginning have been reduced through widespread reduction in the number of old gins, and the introduction of far more effective ginning machinery than was available 25 years ago.

Insofar as production volumes are concerned, the remaining high-density cotton districts not only have retained their former outstanding positions but have improved their relative importance since 1924. The east Texas sectors constitute a major production region despite huge acreage and volume declines (Figs. 9 and 10). These declines, insofar as raw material supply sources influence plant location, have made east Texas relatively less attractive than formerly as a locale for new textile mills.

Today the Mississippi valley leads in total acreages, total volume, area involved, and in per-acre productivity. The Black Waxy Prairies have been displaced as the leading American cotton production district and the center of production in the Southeast has migrated eastward. The older eastern districts now display a resurgence in productivity which was unexpected two decades ago. Their influence has been so strong that the median center of cotton production within the Southeast has migrated from extreme southwestern Arkansas *eastward* the width of the whole state of Arkansas (Figs. 1 and 9). The present median center (1944) is in northern Sunflower County, Mississippi. The center also has shifted northward about 85 miles, obviously as a consequence of the large increases in productivity in the northern Mississippi valley tri-state district, the Georgia–Carolina Piedmont, and the middle Tennessee valley in northern Alabama

(Fig. 9). Comparison of Figures 2 and 10 reveals the present principal cotton growing areas as more nearly isolated nucleii than in 1924.

DELIMITATION OF THE PRESENT COTTON REGIONS

Until recently, no geographer had specifically cited the discontinuous nature of the old "Cotton Belt" and had suggested that it now is "broken." Several sources, including standard texts used in college geography instruction, have recognized the nodular distributions in cotton production within the old "Cotton Belt" for some time.[18] In some cases these areas of large cotton acreages and output have been identified by the number of farms producing cotton in specified volumes, or by other criteria partially extraneous to the crop itself. A number of authors—mostly non-geographers—have commented upon the development of new types of agricultural practices which have displaced cotton as a dominant land-use item between nodular cotton sectors of the Southeast. Evidence of acreage declines and production shifts cited previously in this discussion confirms the contention that the old "Belt" no longer exists.

Erickson first recognized the extensive rearrangements, affixed boundaries to what he believed to be the present

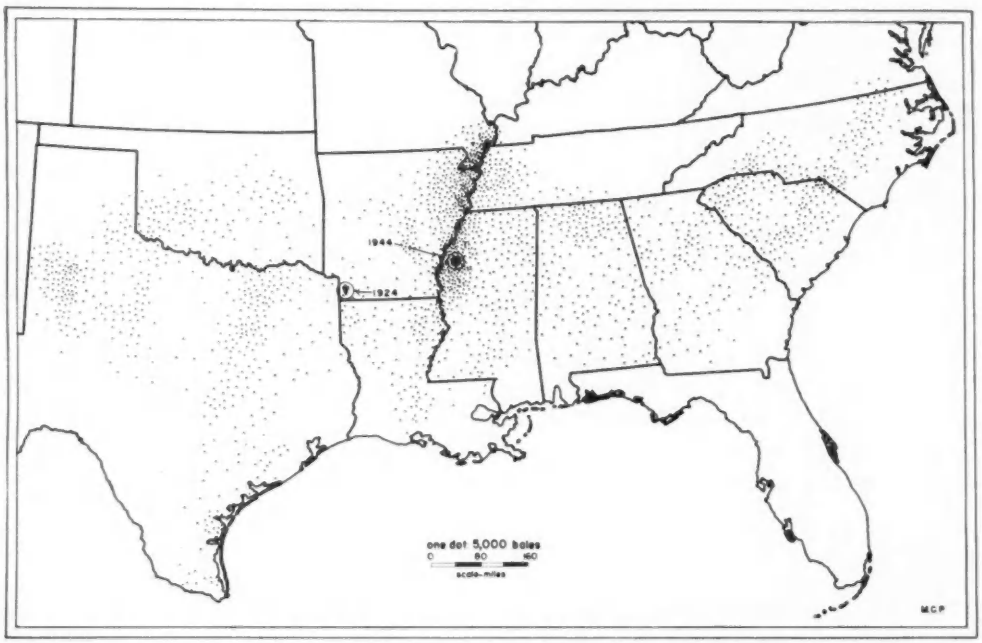


FIG. 9. Cotton harvested, bales, 1944, U. S. Southeast. Based on county unit data from U. S. Census of Agriculture, 1945. Median center of cotton production by volume for 1944 indicated by large circled dot. The 1944 median center was located in northern Sunflower County, Mississippi. Computation of median center position involved the Southeast only; the western irrigated districts were excluded. The 1924 median center was transferred from Figure 1. (A median center was used instead of a mean center because the median is considered more stable and is less influenced by extremes. The median center was determined via two orthogonal lines each of which divides cotton production values into two equal units. The point of intersection of the two lines is the center, sometimes referred to as the median point. However since use of medians in distributional analysis implies evaluation of centrality, the term median center is preferred in this instance. The results indicated by median centers on Figures 1 and 9 are believed to be conservative; if mean centers had been used the migration of the 1944 center from the 1924 position undoubtedly would have been greater. Hart believes the median is "the best index of centrality for single distributions," in contrast to means used in chronological developments. See J. F. Hart, "An Analysis of some Aspects of Centers," Evanston, Ill., 1949, unpublished manuscript, Northwestern University Library.)

cotton regions, and labelled the product a "Broken Cotton Belt" in 1948.[19] Unfortunately, Erickson failed to clarify criteria used for regional delimitation and insofar as can be seen his boundary remains a subjective interpretation. He did not recognize cotton in a secondary role outside the primary production areas, which probably is necessary if an accurate portrayal of the total Southern landscape is to be achieved.

In attempting to arrive at a method for delimiting the present primary production districts, the percentage of value produced by lint cotton out of the value of all farm products was mapped (Fig. 11).[20] Use of proportionate value by itself for regional differentiation is subject to a number of criticisms but its use in conjunction with other devices is desirable. Figure 11 indicates known conditions in the Texas districts fairly well but overemphasizes the areal significance of cotton east of the Mississippi. The greater per-acre productivity of the eastern areas is responsible for this, but equally important is the fact that the value produced by non-farm woodland is not encompassed by the basic figures. This is a serious consideration from a geographical viewpoint, since about half of the total area of the Gulf and South Atlantic states is in woodland (two-thirds of Georgia is in forest).

Mapping of the proportion of cotton acreage in the total cropland harvested resulted in reasonably adequate delimitation of the east Texas prairies and Mississippi valley areas but obscured the eastern districts and reduced and distorted the west Texas high plains area (Fig. 12). Per-acre productivity being high east of the Mississippi, a much smaller proportion of cropland is needed to produce the same value as in western areas. Normally the value of cotton produced in any eastern area is considerably greater per pound than that of any Texas-Oklahoma sector because of greater staple length, greater uniformity, and better color. Stated in other words, while percentage of value overemphasizes the importance of the eastern districts because of productivity and quality differences, percentage of total cropland planted to cotton tends to minimize the significance of eastern cotton principally because of regional differences in the same factors! Neither of these measures evaluates the position of cotton as one of many components within the total southeastern landscape because neither is based on a unit of measure which encompasses all types of land occupance. The relative position of southeastern woodland should not be omitted. From a geographical viewpoint, both Figures 11 and 12 are helpful. In particular the outer isarithm of either can be used successfully for delimiting the outer margins of *secondary* cotton culture.

Use of percentage of cotton acreage harvested in the total land area rationalizes most objections (Fig. 13). Since the basic data for this delimitation encompass the proportionate position of cotton culture within the total landscape, including all woodland, the results appear to be the most effective available for geographical purposes. The regions delimited coincide closely with the high-density areas shown on Figures 8 and 9, and correspond to field observations throughout the Southeast.

The 8.51 per cent isarithm (selected by natural frequency graph distributions) on Figure 13 encloses only about 14 per cent of the total cotton-producing area in the Southeast. Even in the areas of large cotton production the proportion of the total area planted to cotton is surprisingly small. These high-density areas produce slightly less

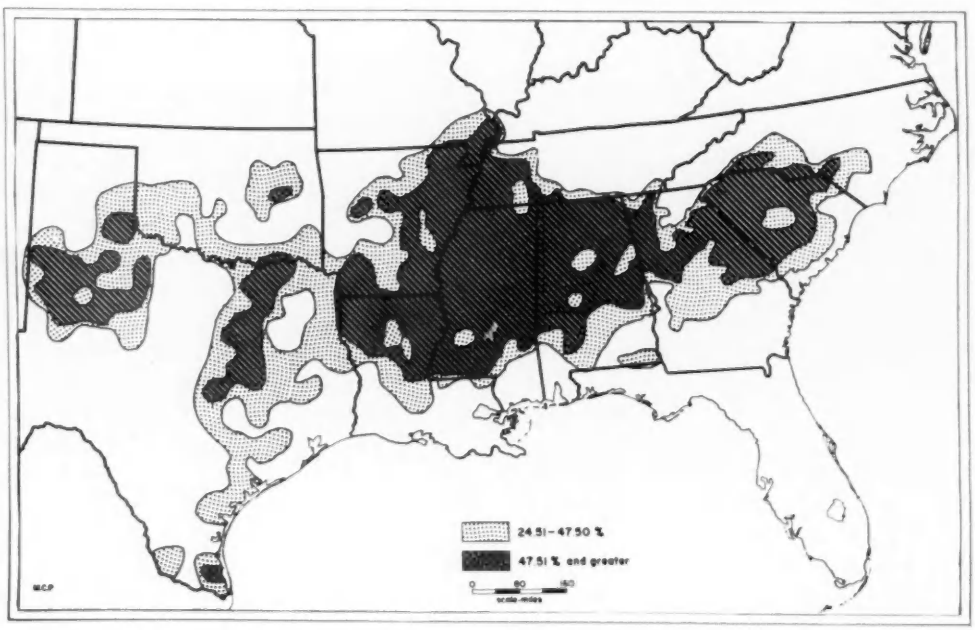
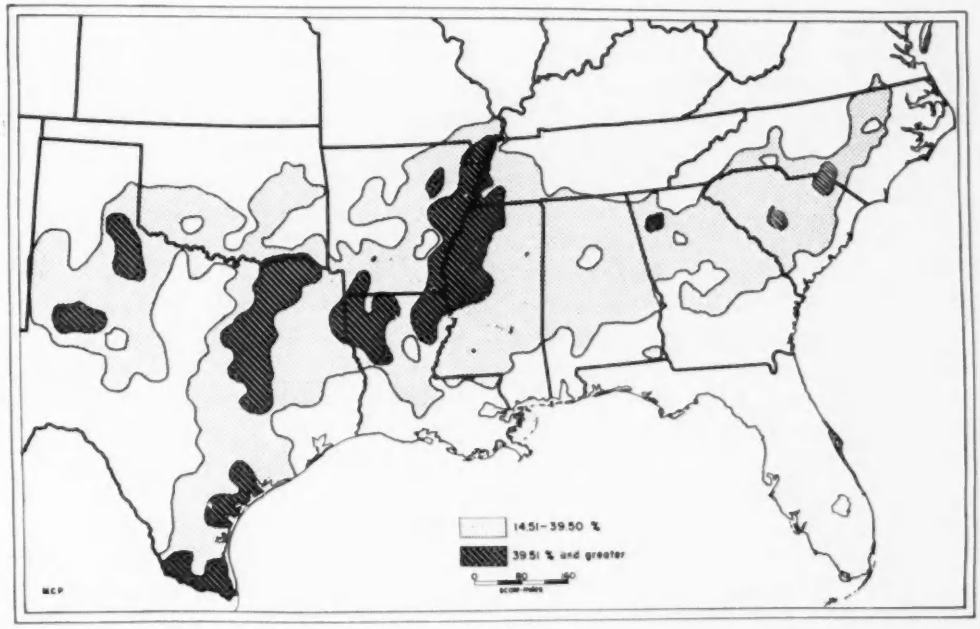


FIG. 10. Cotton acreage harvested, 1944, U. S. Southeast. Based on county unit data from U. S. Census of Agriculture, 1945.

FIG. 11. Lint cotton harvested, 1944, percentage value of all farm products sold, U. S. Southeast. Compiled from county unit data from U. S. Census of Agriculture, 1945.

than 60 per cent of the South's cotton crop, but half of the counties within them had 15 per cent *or less* of their total area planted to cotton in 1944. In more than half of the cotton-producing Southeast enclosed within the 1 per



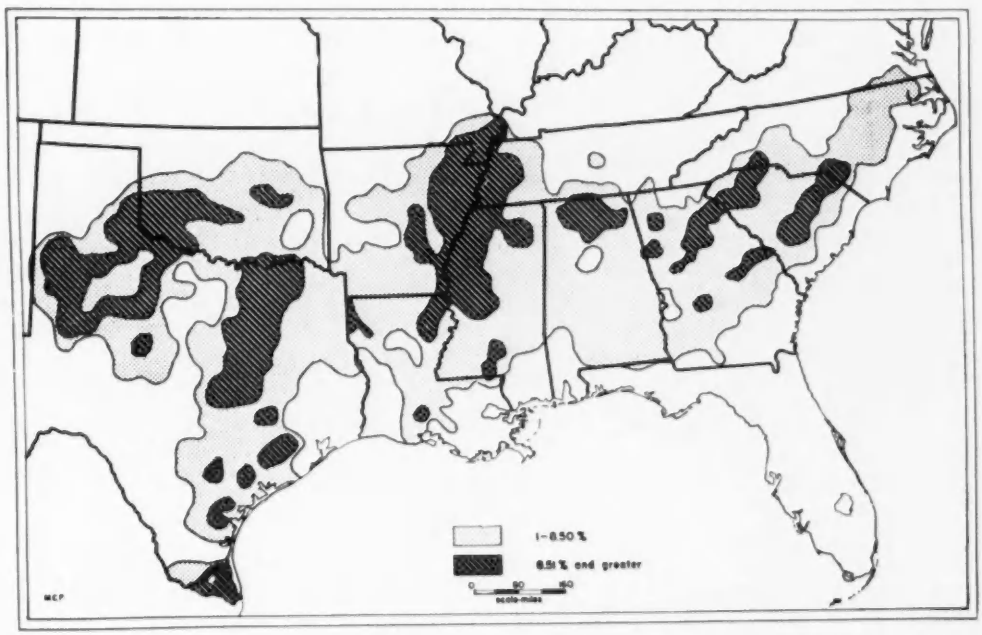


FIG. 12. Cotton acreage harvested, 1944, percentage of all cropland harvested, U. S. Southeast. Computed from county unit data from U. S. Census of Agriculture, 1945.

FIG. 13. Cotton acreage harvested, percentage of total land area, 1944, U. S. Southeast. Computed from county unit data from U. S. Census of Agriculture, 1945. Throughout most of the old Cotton South cotton retains only a secondary position in the total landscape, and the "Cotton Belt" as such has disappeared. Today there are seven "Cotton Regions": (1) The Georgia-Carolina inner coastal plain, (2) the Georgia-Carolina Piedmont, (3) the Tennessee Valley in northern Alabama, (4) the Mississippi Alluvial Valley, (5) the northern "Black Waxy" prairies of Texas, (6) the south Texas coastal plains, a discontinuous region, and (7) the high plains of western Oklahoma and Texas.

cent isarithm (Fig. 13), 6 per cent *or less* of the total area was devoted to cotton. In fact, in 1944 at least 30 per cent of the cotton growing counties of the South had 2 per cent or less of their total area in cotton. The proportionate position of cotton in the landscape never has been so large as popular accounts have tended to indicate, and today in most of the South cotton occupies an important but minor position in the total scene.

Contraction of production into the present high-density areas is perhaps best indicated by Figure 14. The basis for this map is the 8.51 per cent isarithm of cotton acreage in per cent of total cropland, used in computing the distribution of the current major cotton areas. The same value was plotted upon 1924 data to indicate the size of the principal districts *if* 8.51 per cent had been a natural frequency for delimitation as indicated by 1924 data (which is not the case, of course). The value of this map is that of relative, not absolute, comparison, and the significance of the 1924 distribution is restricted. Nonetheless the comparison indicates two things clearly: (1) that the present high-density areas were nodular to the high-production districts of 1924 and acreage declines have reduced the 1924 districts to residual sectors, apparently destined by inherent advantages to retain their cotton-culture characteristics for many years; and (2) that the "Cotton Belt" in 1924 did not exist as a contiguous area.

Today there is no "Cotton Belt" in the American Southeast. Instead there are *seven cotton regions.* These are (Fig. 13): (1) the inner coastal plain in Georgia and the Carolinas, including

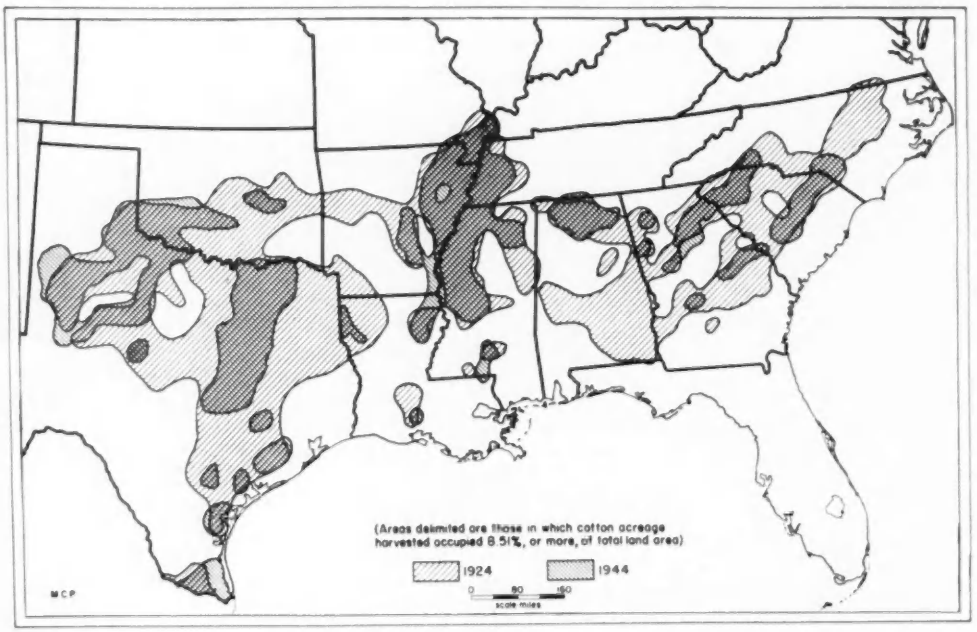


FIG. 14. Relative distribution of high-density areas, 1924 and 1944, cotton acreage harvested in percentage of total area. Computed from county unit data from U. S. Censuses of Agriculture, 1925 and 1945. The areas shown for 1944 are the present cotton regions as indicated in Figure 13. Boundary for 1924 distributions based on 8.51 per cent isarithm which in turn was selected from frequency graph plotting of 1944 percentage of total land area occupied by cotton harvested; the boundary for 1924 is therefore purely relative. The present cotton regions of the Southeast are residual cores of 1924 districts which had much greater areal extent. (This map is the outgrowth of a suggestion made by Dr. Richard Hartshorne.)

discontinuous outliers; (2) the lower and central Georgia–Carolina Piedmont, including outliers in northwestern Georgia; (3) the northern Alabama sector of the middle Tennessee valley; (4) the Mississippi alluvial valley; (5) the northern "Black Waxy" prairies of Texas; (6) the south Texas coastal plains as a discontinuous region and including the lower Rio Grande valley; and (7) the high plains of southwestern Oklahoma and western Texas, including the upper Canadian, Brazos, Colorado, and Red River valleys, the Llano Estacado, and intervening sectors. Use of the term "Cotton Belt" should be abandoned because of its general connotation which present conditions do not justify.

CONCLUSIONS

The results of the quantitative changes in cotton production since 1924 in the United States Southeast have been: (1) a decline of about 48 per cent in acreages planted, which has decreased the size of the primary production districts and reduced the proportionate significance of cotton in the other, secondary, areas of the cotton South; (2) an increase in productivity, particularly in the Mississippi valley and the areas to the east of it, which has intensified cotton production in the core areas existing in 1924; (3) as the cotton regions of the Georgia–Carolina Piedmont and coastal plains and the Tennessee and Mississippi valleys have increased their per-acre output, they have become relatively more important within the whole structure of cotton production than at any time in recent decades. The result has been an eastward shift in the median center of production, which now is situated east of the Mississippi River; (4) cotton has declined in agricultural and geographical significance about the periphery and between the high-density nodes of its production habitat to a point which indicates that it is insignificant as a land occupance criterion for most of the area in the Southeast. At least it is of secondary importance in the majority of what was the old Cotton South; this suggests that investigations are needed to discover the new land occupance facets of much of the South; (5) finally, there are seven cotton regions in the Southeast today, recognizable as such through delimitation based upon factors innate within the distribution of cotton culture itself. There no longer is a "Cotton Belt," in the sense that the term generally has been used, and the realities of the current distribution of cotton culture indicate that the term should be discarded.

ACKNOWLEDGMENTS

Preparation of the basic materials for this analysis was facilitated and encouraged by Dr. O. E. Baker before his death. The author regrets greatly his inability to demonstrate the fruition of several of Dr. Baker's ideas while he lived. Many of the criticisms of Baker's earlier study of the cotton South which are included herein are restatements of points which he suggested. The author also is indebted to the University of Georgia for research funds granted in 1948 and 1949 which made possible processing of statistics, cartographic compilation, and field observations.

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THE WITWATERSRAND

A UNIQUE GOLD MINING COMMUNITY

Donald R. Petterson

Mr. Petterson is a member of the geography staff at Northwestern University. He was in Johannesburg in 1945 and returned to Africa for four months in the field in 1949.

AMONG the great gold fields of the world, the Witwatersrand of South Africa stands out for its uniqueness. Here the discovery of gold has so changed the economic geography that where once roamed a handful of semi-nomadic cattlemen there is now a vigorously growing industrial and manufacturing community. No other discovery of gold has wrought such a change. Other gold rushes have attracted settlers and helped to populate otherwise empty areas, such as California, Siberia, or Australia. But in none of these has the influence of gold mining been so forceful or lasting as to affect the entire nation. In every other gold mining area the mines have sooner or later declined in both relative and absolute importance.

In South Africa, however, the nation's economic life has aligned itself towards the site of the gold mines. An infertile range of hills dividing the waters of the Vaal from the Limpopo River in a sub-humid portion of the country has become the national center of industry, manufacturing, transportation, and finance. The purpose of this paper is both to examine the Witwatersrand in comparison with other gold producing areas in the world and to discuss the changes it has wrought upon the surrounding area and the nation. After the Witwatersrand is examined in the light of its effect upon the original inhabitants, the chronology of the gold discovery as well as the development of gold mining is discussed. Against this background the true uniqueness of the Witwatersrand will be shown to lie in its impact and effect upon the economy, land use, and population of the immediate environment and of the nation.

Before the Discovery of Gold

Three groups of people, the Bantu, the Boer, and the British, have successively occupied the region of the Witwatersrand. Only the British, however, mined the gold, and in so doing they changed the area from one of pastoralism to one of urban industry. The Bantu, the original settler, and the Boer, his conqueror, wandered freely about the broad and treeless High Veld in search of pasture. To these people the Witwatersrand (Ridge of the White Waters) was but a barren, wind-swept ridge of low hills rising above the veld grasslands. As such it was little desired and little sought.

The Witwatersrand is located in the northern portion of the High Veld about 800 miles northeast of Capetown. The gently rolling surrounding country, known as the High Veld, varies in

elevation from four to six thousand feet above sea level. At the northern edge of the High Veld is the Witwatersrand, extending like an inverted "S" for about 60 miles from Randfontein on the west to Springs on the east. The ridge varies in width from two to seven miles, except the eastern edge which spreads out in a wedge-shaped fashion to a width of 18 miles. Towards the south of the Witwatersrand the streams drain into the Atlantic Ocean via the Vaal and Orange Rivers, while to the north streams empty into the Indian Ocean by way of the Crocodile and Limpopo Rivers. Most of the streams immediately adjacent to the Witwatersrand are intermittent (dry during the winter) making them poor sources of water.

The original inhabitants of the Witwatersrand found the area too dry for the cultivation of crops and consequently both Bantu and Boer counted his wealth in herds of cattle and sheep. The semiaridity of the Witwatersrand and adjacent High Veld is due to its location in the Upland Savanna type of climate. Here there is a reversal of the winds annually in response to the alternate low pressure and anticyclonic systems that are established over the southern part of Africa in summer and winter respectively. In consequence, most of the rainfall occurs during the summer months and is generally heaviest along the Drakensberg, the eastern edge of the High Veld, and decreases towards the west. The average annual rainfall at Johannesburg on the Witwatersrand is 30.9 inches.[1] Annual temperatures are high on the Witwatersrand and the yearly range of temperature is small. Johannesburg averages 65° F. in January; its July average is 50° F. Thus it would appear that precipitation is more important in determining the type of vegetation, soil, and, to a certain extent, the agricultural activity which the inhabitants pursue.

The original Bantu inhabitants and their successors, the Boer settlers, found the High Veld around the Witwatersrand covered with grass which

FIG. 1. Aerial view of the Witwatersrand, looking east from Johannesburg. (Courtesy of South African Railways.)

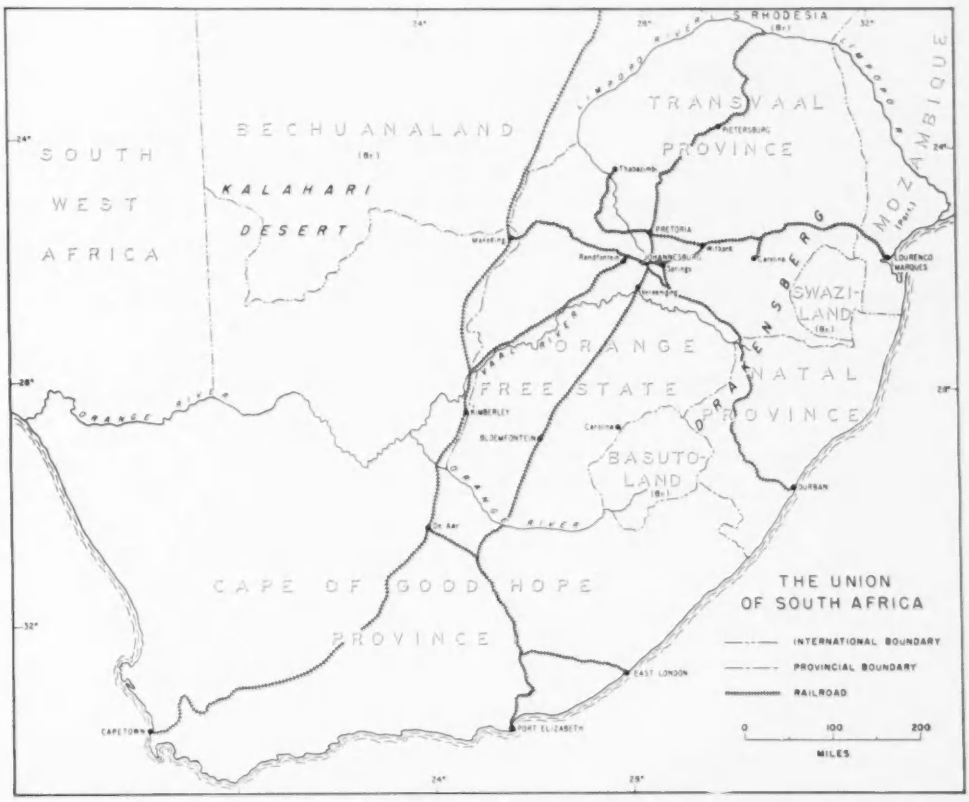


FIG. 2. Johannesburg, approximately at the center of the Witwatersrand, lies in the northern High Veld, 800 miles northeast of Capetown.

extended from the Karoo Desert on the south to the lower and warmer savannas of the north. The prairie and chernozem soil groups which developed on the High Veld in response to the climate and vegetation were potentially productive.[2] Here in a grassland comparable to the Argentine Pampas, the American Great Plains, or the Siberian Steppes, roamed the Bantu and later the Boer, with their great herds of cattle and sheep, ever in search of better pasture.

THE DISCOVERY OF GOLD

When the first Boer settlers came to the Witwatersrand shortly after 1836, they paid scant heed to the prospect of finding gold, seeking instead pasture land. But in 1867 diamonds were discovered in Kimberley, about 250 miles southwest of the Witwatersrand, and professional prospectors and miners immigrated here from all over the world. By 1886 Cecil Rhodes had begun consolidating the diamond holdings into a single company, setting free numerous prospectors and miners to wander elsewhere around the High Veld in search of mineral wealth.

The Main Reef of the Witwatersrand gold-bearing conglomerate was discovered in March, 1886, by George Walker. Further prospecting was rapid, and within the next few months the outcrop of conglomerate beds was found to be continuous for about 60 miles, except for breaks at Witpoortje and Boksburg Gaps. This main gold reef was defined as a bed of conglomerate gold-bearing pyrite ore, varying in thickness but

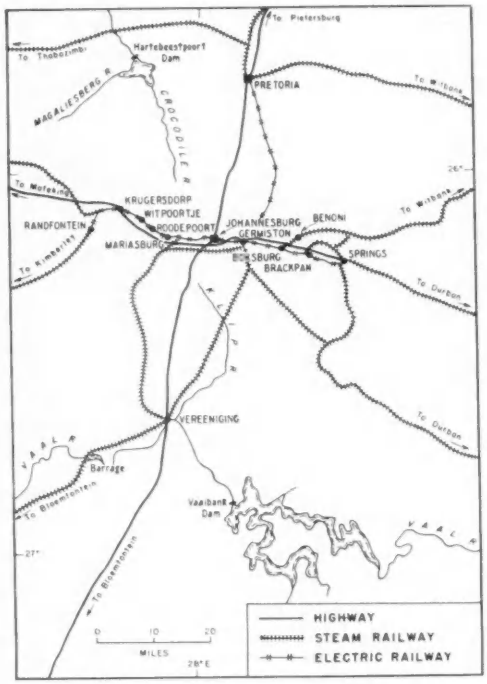


FIG. 3. The towns of the Witwatersrand in relation to surrounding country.

with a maximum width of between six and eight inches, and dipping south at an angle of about 30 degrees.[3]

The Witwatersrand gold reef is unlike any other great gold mining region. There are no glittering nuggets as in Australia, nor the meteoric bursts of the Yukon placers. Instead, this gold reef is a conglomerate composed of rounded quartz pebbles embedded in a fine grained, hard quartzitic matrix. Within the matrix are found the gold particles, usually closely associated with grains of pyrites. This gold reef is remarkably uniform throughout the extent of the Witwatersrand. Other mining regions have flourished, only to become derelict ghost towns when the veins, once heavy with gold, abruptly ended. On the Witwatersrand, however, the uniformity and extent of the gold-bearing ore have insured both a great and an enduring mining industry.

At present the number of tons of gold-bearing ore on the Witwatersrand is yet to be calculated and these mines rank as the richest in the world. On the other hand, however, the Witwatersrand deposits might be classed as the poorest in the world because the average gold content per ton of ore mined is low. In 1946, 4.02 pennyweight of gold was produced per ton of ore mined.[4] In the United States the average richness of gold ore is from three to six times as great. But rich gold-bearing ores are actually rare throughout the world and the poor, but uniform, ores of the Witwatersrand yield tremendous outputs of gold. Thus the problem on the Witwatersrand is not to find the rich gold-bearing ore, but to make the mining of the poor ore profitable.

THE DEVELOPMENT OF GOLD MINING

The Witwatersrand discoveries occurred at a fortunate time in history. They were accessible immediately to the capital amassed in Kimberley; the world demand for gold was critically exceeding the supply; and technology had developed to the point where these low grade ores could profitably be mined. Consequently, the development of gold mining was both rapid and extensive.

Rhodes' amalgamation in 1886 of the Kimberley diamond fields set free capital in the form of money and experience which was able to move quickly and easily 250 miles northeast to the Witwatersrand. No previous gold discovery had attracted such large amounts of capital and organizational ability as quickly and easily as had the Witwatersrand. Here men who had already made their fortunes and not men seeking fortunes dominated the development of gold mining. Hence within six years after the discovery

of gold, the Witwatersrand gold mines were controlled by a limited number of individuals rich in money and experienced in management.

In 1886, prices were low and the world's demand for gold critically exceeded the prevailing supply. As soon as the Witwatersrand gold deposits were proven to be extensive and uniform throughout, a guarantee was provided against world currencies being easily disturbed by violent fluctuations in the supply of gold. It is noteworthy that the last bitter outcry against gold over silver as the principal basis of the world's monetary system was made ten years after the Witwatersrand discovery when William Jennings Bryan in 1896 uttered his famed "Cross of Gold" speech.

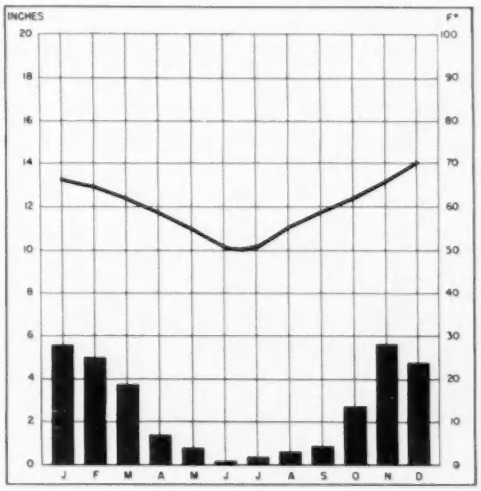


FIG. 4. Climatic chart for Johannesburg. (Source: The Union of South Africa Official Yearbook.)

Finally, the state of industrial technology and chemistry at the time of the Witwatersrand discoveries played an important part in the development of these mines. During the Sixteenth and Seventeenth Centuries the Spanish Conquistadores would have passed over the Witwatersrand fields as impossible to work. Even the California gold miners of 1849 would have been unsuccessful on the Witwatersrand with the technical skill then available. It was between 1849 and 1886 that industrial technology advanced to the point where it was possible profitably to extract gold from low-grade reefs found deep beneath the surface.

A low rate of increase of temperature with depth, averaging 1° Fahrenheit for each 200 feet, contributed to economic mining at levels as far as 10,000 feet beneath the surface. Coal was quickly discovered at Boksburg on the Witwatersrand and later, in 1910, at Witbank, 70 miles northeast, which assured the gold mines of a cheap, available power supply. Hence, Witwatersrand mining soon came under the professional guidance of engineers and technicians and the lone prospector from California or Australia quickly vanished.

URBAN DEVELOPMENT ON THE WITWATERSRAND

Just as the goddess Athena sprang fully formed from the head of her father Zeus, so it might be said that the several urban communities of the Witwatersrand developed almost instantaneously. Here was no orderly measured growth of communities from village to town to city. Instead, several thousand miners encamped on the Witwatersrand before an official proclamation declared the existence of town sites. It was from these camps that the present Witwatersrand communities developed into the several municipalities which are all closely integrated by their primary interest in gold mining and tied together by common transportation, communication, and power and water supply systems.

In no other country in the world have the gold mines been centralized within a single area such as the Witwatersrand. The advantages of this centralization

FIG. 5. A herd of sheep on the gently rolling grassland of the High Veld plateau. The trees in the background have been planted by farmers to protect the farmstead and to provide a source of timber in this treeless region. (Courtesy of South African Railways.)

have had a direct bearing upon the development of gold mining here on a large scale. Little effort is wasted in diffused and decentralized control spread over long distances. Instead, both management and capital can be centralized in Johannesburg where are found the head offices of the mining companies, the banks, and the stock exchange. Similarly, the several Witwatersrand communities enjoy the advantages of centralization as witnessed by their joint efforts in supplying water and power, transportation, and communications.

Gold appears to be the sole reason for the existence of the Witwatersrand urban community. Few natural advantages exist which might offset some of the more obvious disadvantages. For example, the Witwatersrand itself is part of the watershed between the Vaal and Limpopo Rivers which makes the problem of an adequate water supply acute. Furthermore, this gold mining community is not located in the center of any significant agricultural district. On the other hand, the Witwatersrand is easily accessible by highway or railroad. Its situation, moreover, near the

FIG. 6. Johannesburg in 1886, shortly after the discovery of gold on the Witwatersrand. (Courtesy of South African Railways.)

border between the High and Low Veld gives it the advantage of serving both regions. Finally, the Witwatersrand enjoys a warm climate, neither excessively hot nor extremely cold. None of these features created the Witwatersrand community, but they certainly fostered its development and growth.

The largest of the Witwatersrand communities is Johannesburg, located approximately in the center of the area. Here is the "nerve-center" of the Witwatersrand and of the gold industry. Here are found such functions as commerce, banking, and administration. Johannesburg is the largest city in South Africa and the second in Africa. With its high buildings, street railways, and shopping district, it has the external aspects of an American city of comparable size.

In general the city is aligned in an east-west direction, parallel to the main gold reef. In the center of the city, about three-quarters of a mile north of the gold mines, is the principal business district containing the commercial, retail, municipal, and recreational establishments. Secondary industry and light manufacturing in Johannesburg are both directly dependent on the gold mines near which they are located.

The 762,910 people of Johannesburg[5] live in residential districts north and south of the gold mines, the former area being the larger and wealthier. It should be noted that two major groups of people inhabit Johannesburg: Europeans and Non-Europeans (both Bantu and Asiatic peoples). Since only Europeans are permitted to own property within the city limits, Johannesburg appears to be European or White in its external characteristics. Beneath this are the Non-Europeans, particularly the Bantu, living either close by Europeans or isolated into compounds or reserves. Population distribution in Johannesburg, therefore, assumes a pattern comparable to that of both the southern American cities, wherein Negroes are confined to the back alleys of the White residential districts, and

FIG. 7. Aerial view of Johannesburg, looking southeast. The mine dumps south of the central business district indicate the location of the Witwatersrand gold mines. (Courtesy of South African Railways.)

the northern American cities where zoning ordinances segregate Negro and White populations.

The Non-Europeans in Johannesburg (430,884 in 1946)[6] dwell in one of three places: within one of the mine compounds, if they are employed by the mines; on their employer's property if they are domestic servants; or in the Native Reserves of Alexandra or Sophiatown, north and west of Johannesburg respectively. These latter districts are the true slums of Johannesburg where Non-Europeans, unable to own property within the municipal boundaries, live in crowded and unsanitary conditions. Non-Europeans who are domestic servants live at random throughout the city and fare better than those in the reserves. Their housing ranges from individual dwelling buildings on the corner of an estate to dormitory rooms on top of an apartment building. The mine compounds, the remaining type of Non-European dwelling, housed in 1946 approximately 301,000 Bantu laborers employed by the mines.[7] Here Bantu men live in groups of eight or twelve in a room, each man with a cement bunk and a locker. Wash rooms, showers, and dining halls are each shared by several hundred Bantu men.

As previously noted, the Witwatersrand is easily accessible to both rail and highway transportation, and this has played an important part in furthering its growth. In 1889, three years after the discovery of gold, a railroad was built connecting the towns of the Witwatersrand. Since it was then considered cheaper to build the right-of-way around the hills rather than construct cuts, fills, or tunnels, the railroad today follows a twisting course. In addition to the railroad, two major highway routes intersect within Johannesburg. The Main Reef Road, connecting all of the Witwatersrand communities, bisects at a right angle the Great North Road extending between Capetown and Bloemfontein in the south and Pretoria and Rhodesia to the north.

About six miles east of Johannesburg is Germiston, with a population of 131,197 in 1946,[8] the rail center of the Witwatersrand. Here the principal rail route of the Witwatersrand crosses the railway connecting Pretoria with Bloemfontein and Capetown. As a result of this juncture, the largest railway repair and construction shops of the nation were established in Germiston following the Anglo-Boer War. During the first World War, small arms and munitions were manufactured in Germiston. From this small beginning there has since grown a manufacturing center in Germiston ranging from the garment industry to the manufacture of agricultural implements. Here, also, is the site of one of the principal electric power generating stations for the Witwatersrand, as well as the Rand Gold Refinery where all gold mined on the Witwatersrand is refined before being sold.

Both east and west of Johannesburg are the smaller towns of the Witwatersrand (Table I), all similar to a certain extent in size, function, and situation. Since each town is located on the main gold-bearing reef, with mining as its principal activity, these towns are not to be regarded as commuting suburbs of Johannesburg, but rather as individual communities centered upon a particular mine or group of mines, and joined with other communities by a closely knit system of transportation and public utilities.

The importance of closely linking the Witwatersrand into a single unit by transportation was early recognized when in 1889 the railway was built

TABLE I

POPULATION OF SMALLER TOWNS OF THE WITWATERSRAND*

Randfontein	32,493	Benoni	74,176
Krugersdorp	71,909	Boksburg	53,451
Roodepoort-Mariasburg	72,177	Brakpan	83,211
		Springs	111,155

*Data from Union of South Africa, Population Census of May 7, 1946, Pretoria, 1948, p. 18.

along the main gold reef between Randfontein and Springs. Since that time numerous extensions have been constructed, and portions of these are now electrified. Supplementing the railroad net is the highway net which developed rapidly following the first World War. A further indication of integrated transportation on the Witwatersrand is the central commercial airport at Germiston from which scheduled flights connect the Witwatersrand with other cities in the Union as well as North Africa, Europe, and America.

The Witwatersrand communities have joined together in the operation of common communication systems of telephone and telegraph as well as a central system of water and power supply. The problem of supplying water to the Witwatersrand has been acute primarily because the area is located on the Vaal-Limpopo watershed. Since 1903 the Rand Water Board has supplied water to the Witwatersrand municipalities, as well as to the gold mines and the railway. Bore-holes and wells in the bed of the nearby Klip River early proved inadequate and in 1914 the Board constructed a barrage on the Vaal River, 40 miles to the south. This too proved inadequate and in 1937 the Vaalbank Dam, 50 miles southeast, was completed with a reservoir from which 130,000,000 gallons of water are obtained daily. Electric power for the Witwatersrand is also obtained from a single source, the Victoria Falls and Transvaal Power Company, Ltd., and its subsidiary companies. Thus the Witwatersrand now functions as a single unit closely bound together by a common interest in gold mining as well as by joint community functions.

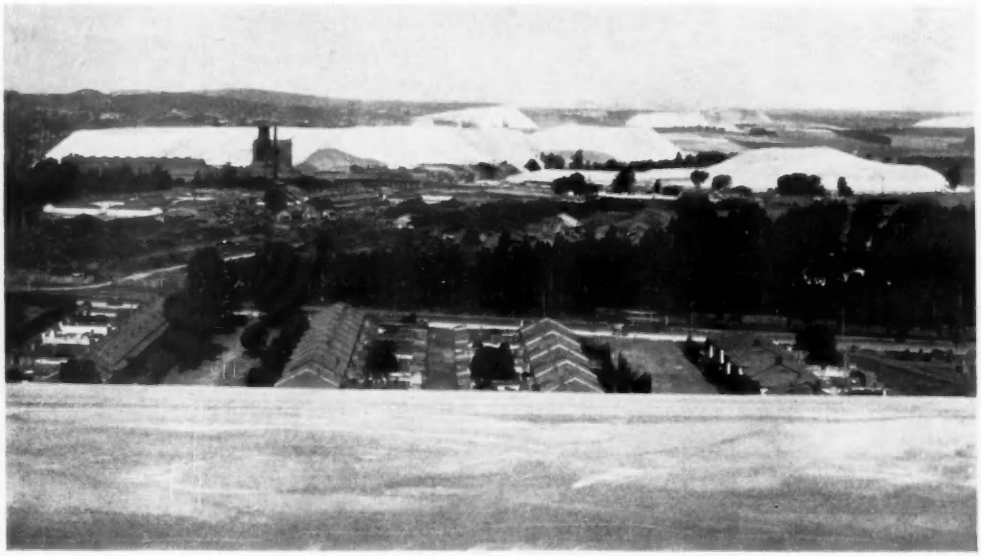
EFFECTS UPON SOUTH AFRICAN ECONOMY

Gradually in the past 50 years the Witwatersrand community has made itself felt upon the surrounding regions, the nation, and the continent. Rail transportation has centered upon the Witwatersrand, heavy heat and power industries have been attracted to the area, and South Africa has changed from a pastoral into an increasingly industrial nation.

Beginning during the first World War and accentuated by the last War, there has been a tendency for gold no longer to dominate the entire industrial economy of South Africa. It is natural that the beginning of the heavy heat and power industries should be in response to the markets created on the Witwatersrand and that these industries be originally located close to the gold mines. Recently, however, the heat and power industries near the Witwatersrand have begun to serve a national market as well as the Witwatersrand. This would seem to indicate the continued growth of an industrial nucleus in South Africa centering about the Witwatersrand.

Thirty miles south of the Witwatersrand on the banks of the Vaal River is the industrial city of Vereeniging. Here extensive coal measures combined with a constant water supply from the river permit electricity to be generated from steam in one of the nation's largest electrical power stations. Some of this electricity is used locally by the two Vereeniging plants producing steel from scrap, most of which comes from the

railway shops at Germiston, on the Witwatersrand. The steel is now being marketed not only on the Witwatersrand, but throughout the Union as well. In 1945 several Vereeniging residents pointed out to the author that in the future the heavy heat and power industry of South Africa would be located there because of the abundant coal supply, proximity to the Witwatersrand market, and the good rail connections with the rest of the country as well as with the British colonies in the north. Plans are now under way



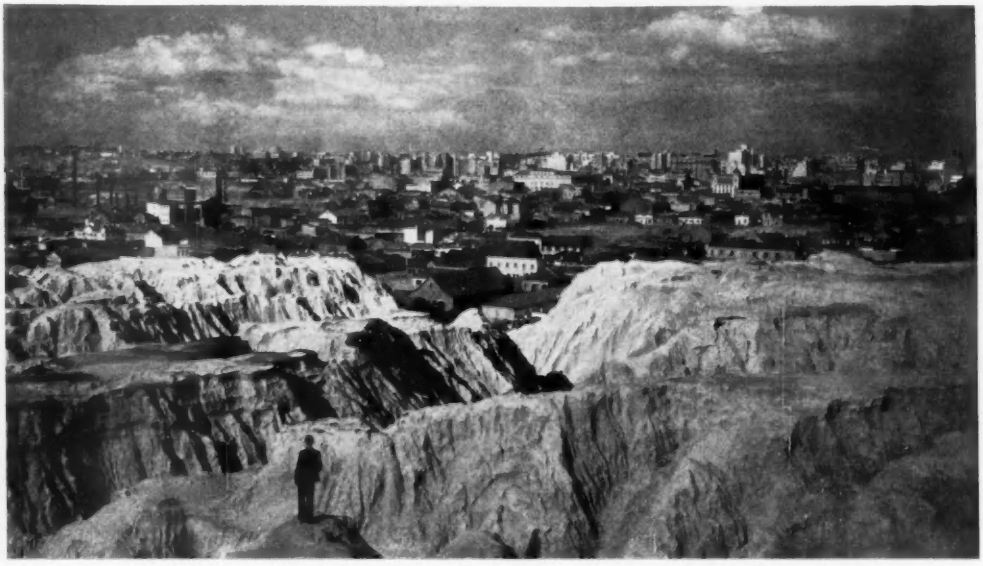


FIG. 8. A Johannesburg gold mine. In the foreground is the Main Reef Road and a branch of the railroad serving the mines. (Courtesy of South African Railways.)

FIG. 9. Johannesburg today. In the foreground are the mine dumps—huge hills of refuse remaining after the gold has been extracted from the low-grade ore. (Courtesy of South African Railways.)

for the establishment of a carefully organized industrial community in Vereeniging.

Another industrial nucleus is established 40 miles north of the Witwatersrand at Pretoria, the administrative capital of the Union. Here the South African Iron and Steel Corporation, Ltd., began steel production in 1934. The iron ore comes from the extensive hematite deposits of Thabazimbi (mountain of iron), 157 miles northwest of Pretoria, the limestone comes from the Pretoria quarries, and coke is made locally from coal mined at Witbank, 50 miles to the east. At present, most of the Pretoria steel is consumed on the Witwatersrand by either the Germiston railway shops or the gold mines. During the second World War, however, small arms and munitions were manufactured in Pretoria, and, following the War, Pretoria steel is gradually being marketed throughout the nation.

Effects upon Agricultural Land Use

The development of the Witwatersrand has wrought an equally profound change upon the use of the agricultural land of the adjacent High Veld. No longer is this grassland area used by the inhabitants for the production of cattle. This has been superseded by truck gardening and maize (corn) production. Though agriculture on the High Veld has not been able completely to supply the demands of the Witwatersrand market for these products, changes in the use of the land have been profound.

Two irrigation districts have been created in the vicinity of the Witwatersrand, primarily to supply fresh vegetables. The Vaal River valley, 30 miles south, has been the site of a truck gardening area since the end of the first World War when a system of barrages and dams was begun. The other truck gardening area serving the Witwatersrand is located 40 miles north, in the Magaliesberg Valley. Here the Union Government inaugurated an elaborate settlement scheme in 1924, following the construction of the Hartebeestepoort Dam.

Though attempts were made throughout the entire High Veld to change from a pastoral to a commercial agricultural land use, much of the region was found due to insufficient rainfall to be unsuitable for crop cultivation. Only in the "Maize Triangle" of the Prairie Soil Group between Mafeking, Carolina, and Ladybrand is commercial agriculture practiced over any considerable area. Nevertheless, only 15 per cent of the total land is under cultivation so there is little similarity to the American Corn Belt. In the latter region the average output is over 20 bags (each of 200 pounds) of corn per acre, whereas the South African Maize Triangle production averages between four and five bags per acre.[9] A winter wheat crop, however, adds considerably to the total cereal production here.

At first the corn of the Maize Triangle was grown for local human consumption and it soon became a staple in the Bantu diet. Recently, however, most of the corn (about 500,000 tons annually) has been exported, through the aid of Government subsidies, primarily to Great Britain. The long journey from South Africa to Great Britain is relatively safe because this grain has a low moisture content due to the subhumid conditions on the High Veld. Consequently, corn is a desirable export crop.

The change in the agricultural land use wrought by the Witwatersrand markets, the accessibility to world markets via the railway, and the stim-

ulus from Government agricultural subsidies has also had serious effects on the arable land. Soil erosion has begun and the most lasting and valuable of the national resources is fast wasting away. In 1944, Hugh H. Bennett of the United States Soil Conservation Service cautioned the Union against this rapid loss of the soil and advised stringent measures of control. Until such action is taken and the High Veld arable land is used extensively rather than intensively, the soil will continue to erode.

EFFECTS ON THE POPULATION PATTERN

The great industrial structure of the Witwatersrand has acted as a magnet, drawing rural population from all of southern Africa towards the mines. Few European children remain on the farms where they were born, turning instead towards the Witwatersrand and mining. Among the Bantu population the problem is even more acute, for the majority of Bantu males leave their native village at least once during their life to serve an 18-month term in the mines. Many of the vices and few of the virtues of urbanization are thus brought back to the Bantu villages and local tribal life is rapidly becoming disorganized and broken. Thus the population of South Africa is shifting and tending to center around the Witwatersrand, resulting in the "Native" and "Poor White" problems.

Of these two problems, the former is perhaps the more serious in its ramifications. The gold mines, in order to operate on the small margin of profit allowed by the low grade gold-bearing ore, must have a constant supply of cheap, unskilled labor. To insure a constant source of Bantu labor, a system of direct taxation has been inaugurated whereby every Bantu who has reached 18 years of age must pay a personal tax, known as the General Tax, of one pound per year.[10] Thus the Bantu labor complement required by the gold mines is assured.

At the Witwatersrand gold mines "almost all of the manual work is performed by Natives (Bantu) under the supervision of white men (Europeans)."[11] Furthermore, Bantu wages are limited by law, for only thus is the labor cost per ton of ore mined kept within the narrow margins of profit. Such a labor structure in gold mining is without parallel today. The ancient mines were based on forced labor, as were the gold mining activities of the Spanish Conquistadores. But the more recent gold mining industries of California, Australia, and the Yukon have all had a free labor policy. On the Witwatersrand, however, a caste system has evolved, and the Bantu is born to serve and the European to direct.

From this rigid caste system there has also arisen the "Poor White Problem." Since the time of Paul Kruger the great Boer farms have rapidly dwindled in size as they have been divided among succeeding generations. Consequently, the grandchildren of the Transvaal Republic Burghers found themselves on farms too small and too poor to gain a reasonable livelihood. The dispossessed European might desire to become an unskilled laborer, but is prevented from doing so by custom and law. The labor caste system developed with the Witwatersrand gold mines, wherein the European directs and the Bantu serves, does not allow for poor Europeans or unskilled Europeans. The "Poor White Problem" grows increasingly serious with time.

SUMMARY

In the early settlement of South Africa the coastal ports of Capetown

Durban, Port Elizabeth, and East London were the chief focal points and population centers. In 1836 the Great Trek northward occurred and Pretoria of the Transvaal and Bloemfontein of the Orange Free State became the centers of Boer life. By 1870 Kimberley assumed importance as the diamond capital of the world. But the gold fields of the Witwatersrand, opened in 1886, rapidly outgrew all the preceding centers and the economic, commercial, industrial, and transportation activities of South Africa focussed upon this site.

Such an evolution has been without parallel in the history of gold mining throughout the world. Ancient gold mining often became transitory when primitive techniques could not wrest further gold from a given site. The great Spanish search for gold in the new world left havoc and destruction in its wake. Gold rushes to California, Australia, and Alaska all opened new regions for settlement, but, in the history of each of these places, gold mining soon gave way to other economic pursuits. Only in South Africa has gold mining dominated the national life for a long period or been of sufficient influence to markedly change the relationship between man and his environment.

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LAND USE IN NATAL

Keith Buchanan and N. Hurwitz

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NATAL can lay no very great claim to importance in the general European farming economy of the Union of South Africa; in round figures it contained in prewar days only one-twentieth of the gross area of European farms in the Union, and only one-twelfth of the land under agricultural crops. Its productivity in terms of cereal output is not outstanding; taking only the three main cereals, wheat, maize, and kaffir corn, the total output per 100 morgen (one morgen = 2.1165 acres) of farm area in the Province in the days before World War II was only 39 bags, as against 82 in the Orange Free State. The cattle density of the Province was, it is true, relatively high—17 per 100 morgen as against 12 in the Orange Free State—but sheep density was very low: 35 morgen as against 63 in the Orange Free State. These examples could be added to indefinitely. They suggest that the flattering descriptions of Natal as the "Garden Province" or the "Pantry of the Union," which have become so fashionable of late, are rooted largely in geographic ignorance.

To a geographer, the dominating features of the agricultural situation in the Province are threefold: the medium or low productivity of much of the Province's land surface; the failure of the Province's agriculture in prewar days to meet in full the nutritional requirements of Natal's 2 million people; and, thirdly, the imperative necessity, in view of its rapidly expanding population and the low level of living of a large proportion of the people, of rapidly expanding the Province's food output. To achieve such an expansion of output without making inroads into the soil capital of Natal it is necessary first and foremost to attempt an assessment, if only on broad general lines, of the productivity of each part of the Province and of its suitability for various types of land use. Secondly, the initiation of detailed land use survey work, which will give a picture of the existing land use pattern of the Province, is hardly less urgent. Thirdly, as the basis for any policy of planned land use, it is essential to attempt an evaluation of the gap between the nutritional needs of the population, on the basis of certain generally accepted standards, and existing production; this is especially important in the case of the protective foods (milk, vegetables, and fruit). Each of these aspects is discussed briefly in the following pages.

PRODUCTIVITY AND CLASSIFICATION OF LAND IN NATAL

The major geographic factors affecting the agricultural potentialities of the various districts of the Province are

relief, climate, and soil. Of these, soil is perhaps the least important, since, given satisfactory depth and water relations, both of which are in large measure functions of relief, the farmer can, and does, build up a satisfactory fertility status in his land. In Figure 2 attention is therefore focussed upon the factors of relief and climate. Areas where the character of the relief or of the climate is likely to prove a limiting factor to the development of a well-balanced agriculture are indicated by various types of hatching; steeply slop-

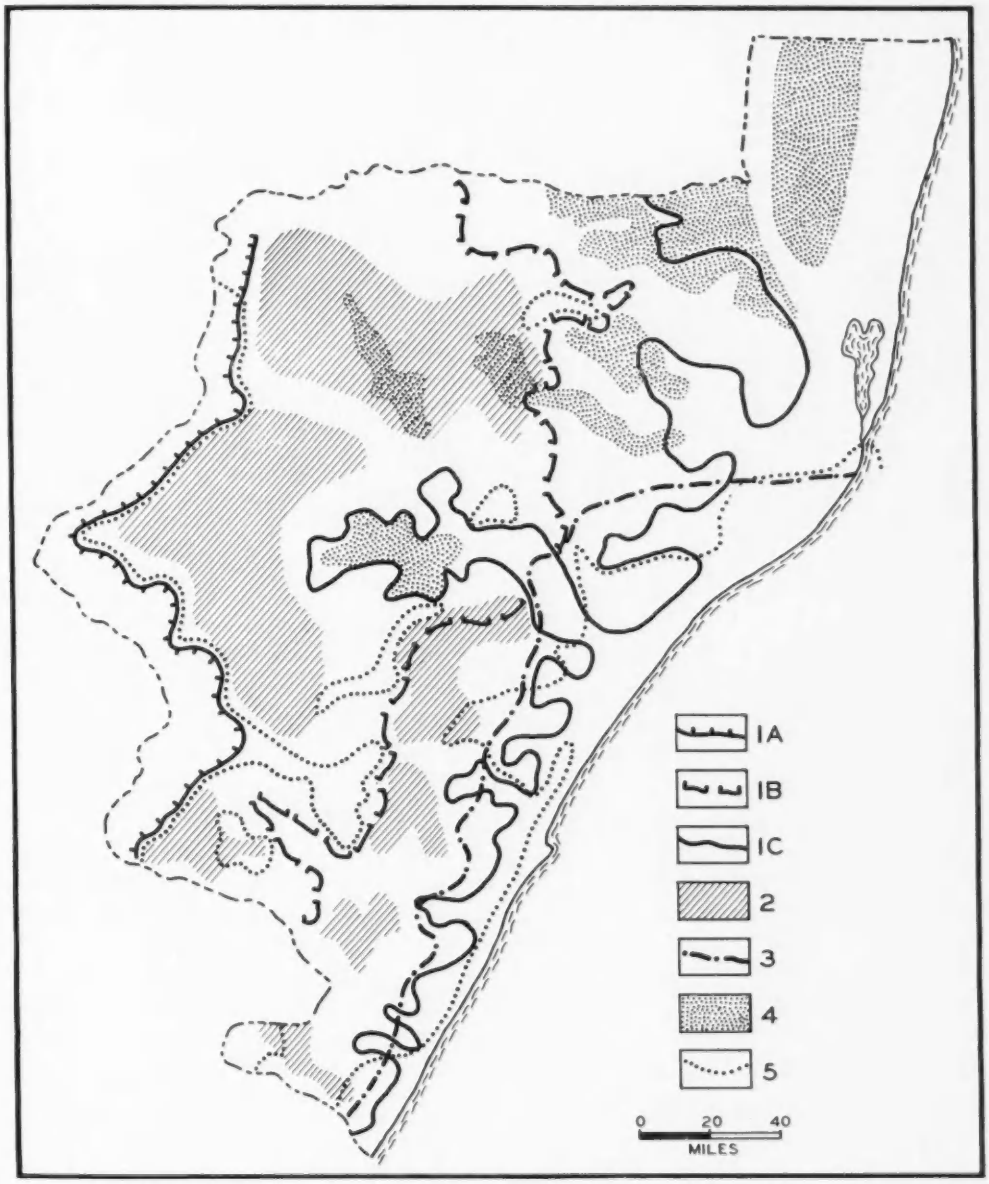


FIG. 1. Major elements in the physical background of Natal. Indicated are: 1. eastern limits of major peneplain surfaces—A. Drakensberg, B. Midlands (4000 feet), C. Camperdown (2000 feet); 2. major flat lands above coast plain; 3. climatic region of humid coast plain; 4. dry belts of interior; 5. boundary of high rainfall belts of coast and of interior hills.

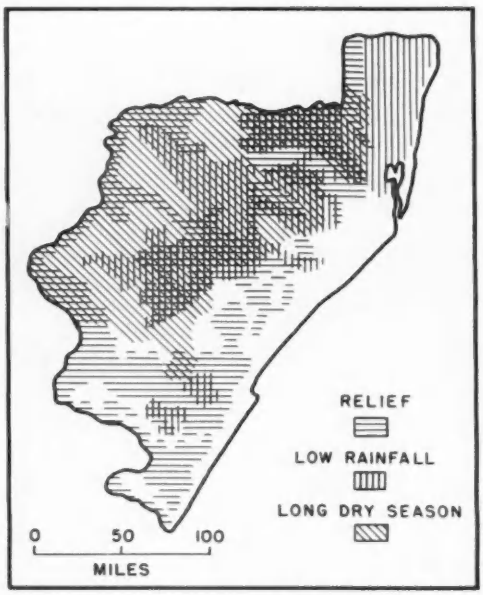


FIG. 2. Factors limiting agricultural development. Criteria upon which this map is based are given in text. Note the relatively small proportion of the Province's land that does not suffer from one or more limitations to agriculture. A realization of these limitations is essential for a sane policy of land use.

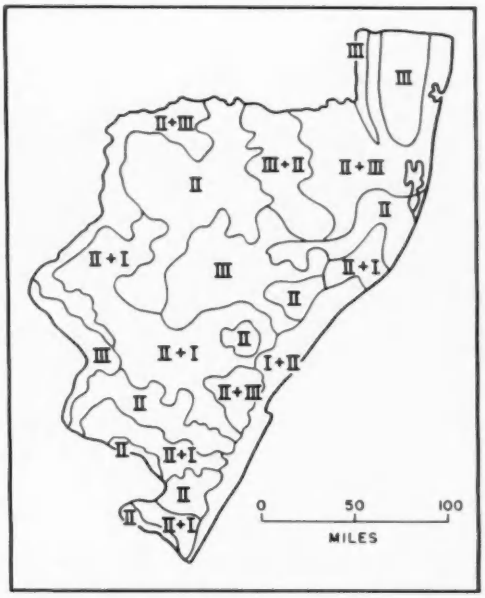


FIG. 3. Land classification regions. This is a highly generalized map. Definitions of the several categories used are given in the text. Owing to the operation of the various limiting factors shown in Figure 2 only 5 per cent of the provincial area falls in the category of good quality farm land.

ing areas are indicated by horizontal hatching, areas with low rainfall (less than 30 inches) by vertical hatching, areas with a very protracted drought period (over 4 months) by oblique hatching, areas where more than one limiting factor are operative are indicated by double or treble cross-hatching. Even though the map represents little more than a tentative assessment of the importance of the geographic factor in the Province's agricultural economy, one feature emerges clearly: the very definite disadvantages of relief or climate, or both combined, under which farming must be carried on in many parts of the Province. Realization of these limitations is not only a useful corrective to the rosy-hued concept of Natal as the "Garden Province" or the "Pantry of the Union"; it is an essential basis for a sane policy of land use.

Although relief is a *prohibitive* factor to farming in only limited areas of Natal, over much of the Province the broken or undulating nature of the topography places a limit on the potentialities of the land and calls for a special adjustment of farming practices to safeguard both veld and ploughland. The relief factor, including the closely related factor of shallowness of soil, attains its maximum importance in the vicinity of the Drakensberg, is the only major limiting factor operative in the climatically-favored southern districts, and is of special importance in the heavily dissected drainage areas of the Tugela, Umfolosi, Mkuzi, and Pongola.

Climate is a limiting factor chiefly in the interior. Over most of the western interior and over much of Zululand the drought period is protracted and severe, so that the long days

FIG. 4. Tall-tree savanna in Zululand. Land of limited productivity owing to adverse topography and low rainfall. Over much of Zululand the drought period is protracted and severe, and the long days of winter sunshine are virtually useless for plant growth. View from Hluhluwe looking east.

FIG. 5. Gallery forest of subtropical vegetation in northeast Zululand.

FIG. 6. Heavily dissected country in east-central Natal. Deeply incised valleys with high per cent of slope land set aside for Native Reserves; flatter plateau crest (2000 foot level) largely in European farms.

FIG. 7. East-central Natal. Steep submarginal slopes under precarious native subsistence cultivation; flatter land belonging to European farms under pasture or wattle.

FIG. 8. European dairy farm in the vicinity of Pietermaritzburg. Hay being got in foreground; gums, aloes, and thorn trees; dairy farm with milking sheds and silo; thornveld on hill in background.

FIG. 9. Marginal land on the fringe of the 2000-foot Platform. Hillside on left under natural thornveld; flatter land on inside of meander loop cleared for pasture. Hill land is Category III (see Fig. 3); valley land, II.

of winter sunshine are virtually useless for plant growth. Only along the coast and in the southern districts is the dry period relatively short and the number of rain days high. The area with low rainfall (under 30 inches) is less extensive than the area suffering from a long dry season and coincides broadly with the drainage area of the Tugela and its tributaries, and of the Umfolosi, Mkuzi, and Pongola. Throughout this area the rainfall is highly concentrated in character and locally the average precipitation drops below 20 inches, with consequent limitations on both crop and livestock production.

It will be evident from Figure 2 that a wide area of central and northern Natal suffers from the operation of all three limiting factors discussed. The area which includes the Tugela valley in the districts of Weenen, Msinga, and Nkandhla and the valleys of the Umfolosi, Mkuzi, and Pongola is essentially marginal as far as normal farming is concerned. A rational land use policy for the area would seem to call for a rigorous application of conservation techniques to offset the high erodibility of the area due to broken relief, for a heavy emphasis on drought-resistant crops such as the sorghums to offset the climatic limitations of the area, and for a low density of human and livestock population in conformity with the low carrying capacity of such land. As population maps of the Province will show, however, parts of this marginal region, and especially the vicinity of the Tugela, are carrying some of the densest agglomerations of rural population in the interior of the Province.

The area shown unhatched on the map, i.e., the area with a level or only gently rolling relief and an adequate and fairly evenly distributed rainfall, constitutes only a small proportion of the provincial surface. The major stretch of such land coincides broadly with the humid coast belt; here, between Port Shepstone in the south and Cape St. Lucia in the north, and stretching inland for from five to twenty miles, is to be found the greater part of the Province's best farm land. Smaller areas of such land, enjoying similar advantages of topography and climate, occur in the Midlands and in the southwest towards the fringes of the Berg; though the aggregate area of these is much less than that of the coastal belt they share the latter's potentialities as centers of intensive agricultural production.

With this map as a basis it is possible to draw up a tentative land classification or productivity map of Natal (Fig. 3).

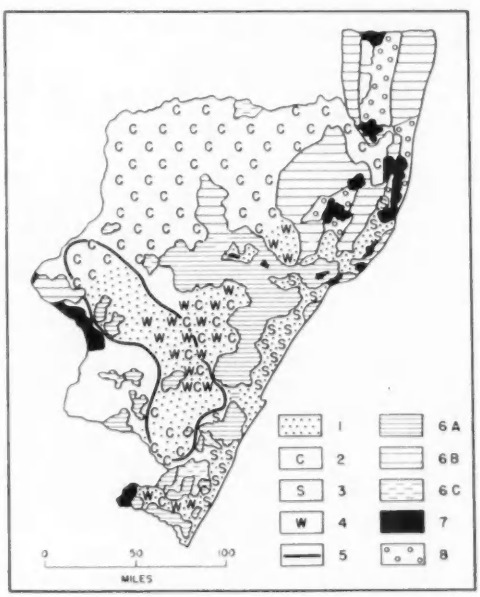


FIG. 10. Land use in Natal, showing the dominant economies within the European agricultural area, the main types of native subsistence farming, and the major areas of non-agricultural land. "Released Areas" are those areas formerly in European occupation that are being transferred to the Native Reserves of the Province. Indicated are: 1. zone of more intensive European farming; 2. cereal belt; 3. sugar belt; 4. wattle belt; 5. zone of intensive animal husbandry; 6. native subsistence farming (A. high density, B. low density, C. Released Areas); 7. non-farm land; 8. crown land.

It is clear that the factors affecting land quality can be grouped under the two headings of physical and human factors. The physical factors can in turn be grouped under three subheadings: (1) site factors, including relief and regional drainage; (2) soil factors, comprising physical properties such as nutrient status; (3) climatic factors, especially amount of rain and duration of drought. The human factors include economic factors such as accessibility and historical factors such as past treatment, e.g., over-cultivation. These human factors are difficult to assess objectively and are impermanent in character and cannot readily be incorporated in any scheme of classification; nutrient status, too, can be comparatively easily modified by man. The scheme of classification here presented is therefore based solely upon the physical factors of soil, site, and climate.

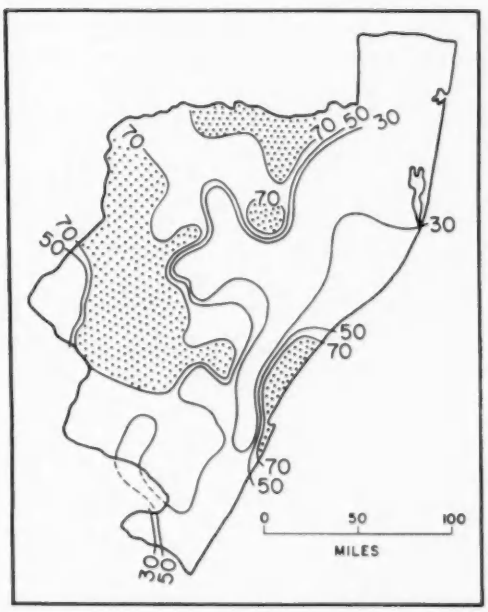
Three main categories have been recognized:

I. *Good quality land.* Highly productive under good management and possessing the following features: (1) topography level to gently rolling, land not too elevated; (2) soils of adequate depth and easily worked; (3) adequate rainfall. Category I land can be cultivated permanently and safely with the production of moderate to high yields of adapted crops without special practices.

II. *Land of only medium productivity* owing to unfavorable operation of one or more factors of site, soil, or climate; e.g., (1) broken or elevated topography; (2) shallowness of soil; (3) inadequate rainfall or excessively protracted dry season. Category II land is suitable for cultivation with special practices; e.g., contour tillage or selection of drought-resistant crops.

III. *Land of limited productivity* by reason of extreme operation of one or more factors of site, soil, or climate. At best, suited to occasional or limited cultivation; at the worst, suited only for controlled grazing or timber production.

Owing to the highly diverse topography of much of the Province and the scale of mapping, detailed delimitation of each individual land category has been possible only in certain areas, and



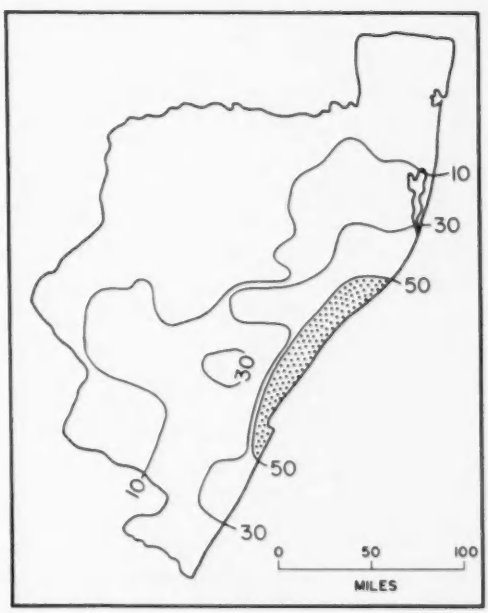


FIG. 11 (left). European farms as per cent of district area. Comparison with Figures 1, 2, and 3 reveals the concentration of European farm land in the physically more favored sections of the Province.

FIG. 12 (right). Cultivated land as per cent of farm area. Concentration of the intensive types of land use in the climatically more favored areas is evident from this map. It should be emphasized that this refers to European farms only.

large tracts have been mapped as complexes of I and II or II and III as the case may be.

On the basis of this tentative map, the following picture emerges:

	Per Cent of the Provincial Area
Category III	19
III with some II	5
Total, dominantly III	24
II with some III	20
Category II	28
II with some I	22
Total, dominantly II	70
I with some II	5

In summary, seven-tenths of the provincial area is of only medium productivity, one-quarter consists of poor quality land, one-twentieth of dominantly good quality land. This may seem an unduly pessimistic estimate; it is certainly true that the subjective element in such a classification is very large and the possibility of an unconscious bias owing to the familiarity of one of the writers with western European levels of soil productivity cannot be ruled out; nevertheless, even making large allowances for such a possible bias, the fact remains that the area of good quality land in Natal is only a small fraction of the whole and its optimum utilization becomes therefore a matter of critical importance to the whole community.

LAND USE IN NATAL

Natal offers many interesting features to the student of land use. Within the Province are to be found two major economies—the barely subsistence economy of the Native Reserves and the cash economy of the European farmer—carried on side by side in territorially segregated areas. Within the European farm area two major crop economies—maize monoculture in the interior and sugar monoculture in the humid coast belt—dominate the agricultural scene; territorially the cleavage between these two forms of cropping is almost as sharp as the cleavage between European farming and native reserve farming. But the agricultural picture is not static and the expansion of the great port city of Durban has been accompanied in recent years by a very marked swing-over to more intensive forms of production and especially to dairy farming through the more accessible southern districts, with the result that a marked concentric zoning of production centering on Durban is becoming apparent (Fig. 21). The marked expansion of wattle growing during the interwar years, especially in the so-called "Mist Belt" of the southern Midlands, has introduced a further element of variety into the agricultural landscape.

In 1936–1937 the area in European farms in Natal amounted to 5,222,000 morgen or 49 per cent of the provincial area. Broadly speaking, European farming attains its greatest importance on the relatively undissected surface of the Midlands and northern districts; here over one-half of the total area is in European farms.

Within this zone of dominantly European farming, two major areas stand out; in both, European farm lands occupy over 70 per cent of the area. The most important lies athwart the main railroad to the interior and stretches from Pietermaritzburg in the southeast towards Newcastle and the coalfield area of northern Natal. This is separated by an area of somewhat lower intensity of European occupance (50 to 70 per cent in farms) from the second major area, lying along the northeastern border of the Province.

As can be seen from Figure 10, European farming is least important, occupying less than one-fifth of the area

of the various districts, in a broad belt of territory stretching from Pinetown in the southwest and from Msinga in the west towards northern Zululand. Locally, at the northern and southern extremities of this zone, less than one-tenth of the total area is in European farms. This is the major area of native reserve territory; climatically it includes the region of the subhumid coast plain; topographically it coincides with the heavily dissected foothill zone of eastern Natal.

Within the coast plain, from Cape St. Lucia southwards, European farms occupy under one-half of the area. The only exception to this is in the heart of the sugar belt and here over 70 per cent of the area is in European farms (Fig. 11).

Cultivated land, comprising agricultural crops, plantation timber, fallow, and fruit, occupies one-seventh of the total farm area and presents a totally different pattern of distribution, attaining its greatest importance, in relation to total farm area, in the humid and subhumid coast plain districts and at low levels, mainly below 2000 feet (Fig. 12).

In the center of the coastal belt between Durban and the Tugela over one-half of the total farm area is under cultivation; whereas in the sugar growing districts of Umzinto, Eshowe, and Lower Umfolosi and in the more inland districts of New Hanover and Kranskop, cultivated land makes up 30 to 50 per cent of the district farm area.

Inland, the proportion of cultivated land drops rapidly. In the districts north of Maritzburg and in the extreme south of the Province, between 20 and 30 per cent is cultivated. Between 10 and 20 per cent is under cultivation in the dairying area up-line from Maritzburg and in the southeast. Over most of the north of the Province, under conditions of low rainfall, and in the foothills of the Drakensberg, the proportion drops below 10 per cent; in parts of Zululand and north central Natal it drops below 5 per cent.

The utilization of the cultivated area in 1936–1937 is summarized as follows:

	Morgen	*Per cent of Total Cultivated Area*
Agricultural crops	450,225	61.3
Pineapples and bananas	4,619	0.6
Orchards	4,560	0.6
Timber and wattle	202,543	27.4
Fallow	72,737	9.9
Total	734,684	99.8

Over most of the interior of Natal the proportion of land under agricultural crops is low. In 19 out of the total of 44 districts, forming a compact block in the north of the Province and stretching south towards Weenen and Pinetown, this group of crops occupies less than one-twentieth of the total farm area. Over the remainder of the interior, with the exception of the vicinity of Maritzburg, agricultural crops occupy between one-twentieth and one-tenth of the farm area. Only along the coast belt does the proportion rise above this level; Durban, Inanda, Lower Tugela, and Mtunzini all have two-fifths or more of the farm area under agricultural crops (sugar making up over 90 per cent of the total) whereas the (sugar growing) districts of Eshowe, Lower Umfolosi, and Umzinto show proportions of one-fifth to two-fifths. In 1936, 450,000 morgen or 8.6 per cent of the farm area was occupied by agricultural crops; this may be compared with the figure of 14.6 per cent in the Orange Free State and the average for the Union of 8.6 per cent.

Of this area in agricultural crops 44 per cent was under mealies, 6 per cent under other cereals, 38 per cent under sugar cane, 6 per cent fodder crops,

and 2 per cent under vegetables, potatoes, and sweet potatoes.

The economy of the Province is, in short, essentially a carbohydrate economy. Nine-tenths of the cropland of Natal is under cereals and sugar, and the major contrast in the agricultural geography of the Province is the contrast between the coast belt, with an economy based on cane and cattle, and the interior, with an economy based on corn and cattle. This broad division is fundamental. Yet, as both field traverses and examination of the agricultural census figures show, neither coast belt nor interior can be considered a homogeneous unit; contrasts in amount of total land cultivated, in intensity of production of the staple crops, in the character of the subsidiary forms of agricultural production—all combine to make possible a further division of the Province into a number of regions, each characterized by a particular assemblage of crops or a particular type of livestock husbandry. The bases upon which this division rests will be made clearer, if, as a preliminary to the identification of land use regions, attention is drawn to the distribution of the major crop assemblages, secondly to the major livestock regions.

CROP REGIONS

Sugar and maize together occupy 82 per cent of the total provincial crop acreage, the former concentrated in the subtropical coast belt, the latter attaining maximum importance in the northern districts. In the south of the Province with the development of dairying fodder crops assume some importance; in the Midlands, especially north of Maritzburg, wattle growing is an important element in the rural economy. Finally, in spite of the Province's flattering title of "The Garden Colony," horticultural crops—fruit and vegetables—are of only limited importance except in peri-urban areas.

Figure 13 presents a tentative division of the Province into crop regions based upon the relative importance of the crop groups that have been discussed. The northern districts are, from a cropping point of view, essentially monocultural, with cereals (maize and kaffir corn) occupying over three-quarters of the crop area. This monoculture is accompanied by a general low intensity of land use; over much of the region less than one-tenth of the area is under cultivation of any sort. A comparable emphasis on cereal production is evident

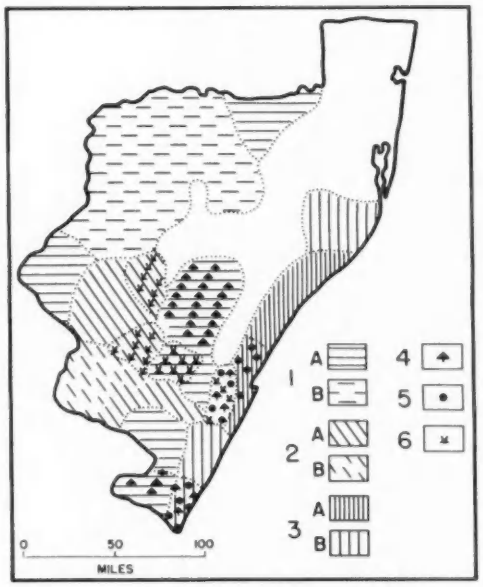


FIG. 13. Crop regions of Natal. This map supplements Figure 10 and gives a more detailed picture of the crop economies of the various parts of Natal. Indicated are: 1. Mealies (maize) dominant (over 75 per cent of crop area)—A. moderate intensity of land use (over 10 per cent of farm area cultivated), B. low intensity of land use (less than 10 per cent of farm area cultivated); 2. Fodder crops (over 20 per cent of crop area)—A. moderate intensity of land use (over 10 per cent of farm area cultivated), B. extensive farming zone (less than 10 per cent of farm area cultivated); 3. Sugar dominant (over 50 per cent of crop area)—A. moderate intensity of land use (less than 50 per cent of farm area cultivated), B. high intensity of land use (over 50 per cent of farm area cultivated); 4. Wattle (over 10 per cent of farm area); 5. Fruit; 6. Vegetables.

in the Maritzburg-Greytown area, and, farther south, in the districts of Ixopo and Alfred. In the former region, however, wattle production introduces an element of diversity into the landscape, and this maize and wattle region centering on Greytown may be considered as a special land use region. The same combination occurs in the extreme south of the Province in the Harding area.

The sugar belt, extending from Lower Umfolosi to Port Shepstone, may be subdivided into several subregions. The center of the belt, comprising the district of Durban, Inanda, Lower Tugela, and Mtunzini, shows a higher percentage of land under cultivation (over 50 per cent) than any other part of Natal. In the immediate vicinity of Durban subtropical fruits become important elements in the economy. Farther south, around Port Shepstone, they again make their appearance, occupying one-seventh the area under sugar; here, too, the wattle and sugar belt overlap. Pinetown, on the very edge of Durban, has a highly diversified crop pattern; fruit occupies about one-tenth of the farm area, wattle also one-tenth, whereas vegetables account for no less than two-fifths of the crop acreage. The district has a very marked agricultural individuality; if any area deserves the title of "Garden of Natal" it is the Pinetown area.

West of Maritzburg, maize is still important, but the development of dairying along the main rail lines has resulted in the marked importance in the local economy of fodder production. In the districts of Underberg, Polela, Impendhle, Richmond, Lions River, Estcourt, and Weenen, strung out along the main rail lines to the interior, this group of crops, including rye, barley, oats, lucern, teff, and other cultivated grasses, occupies one-fifth or more of the total crop area. Subdivisions of this fodder crop region may be suggested: Impendhle and Underberg both show a low intensity of land use, with less than 10 per cent of their total area under cultivation, a feature which distinguishes them from the rest of the region. Weenen and Lions River are distinguished by the development, on a limited scale, of fruit and vegetable production.

Livestock Regions

Figure 14 presents a division of the Province into livestock regions, based upon the character of the livestock economy in various districts.

Cattle constitute the dominant element in the livestock economy. Contrasts in density per unit area between the various districts are nowhere very great and do not offer a basis for any clear-cut division into regions on the basis of intensity of production. There are, however, fairly clear-cut contrasts in the orientation of livestock husbandry between the northern and southern sectors of the Province and these permit of a broad division into the regions outlined in Figure 14.

The northern districts, with the exception of the Dundee area, where a local market encouraged milk production, are characterized by production of beef on extensive lines. Together with the southwestern foothills of the Drakensberg, they are also distinguished by the importance of sheep in the local economy. Throughout the area shown stippled on the map, sheep constitute over one-fifth of the livestock population, measured in terms of livestock units. This sheep raising area extends with hardly a perceptible break through the western sector of the Province; it consists of a central area of high density (over 50 sheep per 100 morgen) flanked by two areas of lower density.

In contrast to this beef and sheep region, the southern part of the Province is characterized by the growing importance of milk production. This dairying belt is oriented along the main rail line from Durban to the interior, and its development is obviously linked with the presence of transport facilities rather than with any great advantages of the physical environment. As defined on the map, this "Milky Way" includes all districts with a milk production of over 750 gallons per 100 morgen of farm area; of the southern districts, only Underberg, Impendhle, and Umzinto fall below this figure. This belt is subdivided on the map (a) according to intensity of production and (b) according to the proportion of the total milk output entering the fluid milk market.

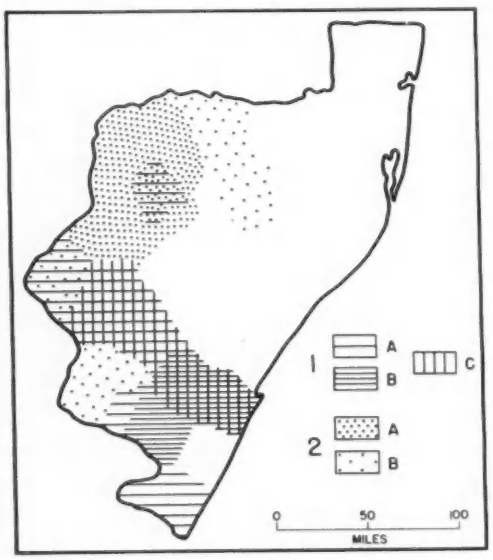


FIG. 14. Livestock regions of Natal. The fundamental contrast here is between the milk belt of the south, oriented along the main rail line to Durban, and the sheep and extensive cattle rearing economy of the less favored northern districts. Indicated are: 1. Milk producing region—A. 750–1000 gallons per 100 morgen, B. over 1000 gallons per 100 morgen, C. over 50 per cent sold as fluid milk; 2. Sheep rearing region (sheep over 20 per cent of total livestock units)—A. area of higher sheep density (over 50 sheep per 100 morgen), B. area of lower sheep density (less than 50 sheep per 100 morgen).

On grounds of intensity of production it is possible to distinguish a zone of moderate intensity (750 to 1000 gallons per 100 morgen) consisting of the districts up-line from Maritzburg and the Alfred–Port Shepstone area and a zone of high intensity (over 1000 gallons per 100 morgen) lying between Maritzburg and Durban. The area within which over 50 per cent of the total output is disposed of in the fluid milk market is more narrowly localized along the main railroad; it extends from Estcourt to Durban but excludes the producing districts to the south including Ixopo.

LAND USE REGIONS

Figure 15 presents a tentative division of the Province into land use regions based upon distinctive combinations of crops, upon the character of livestock husbandry, and upon the intensity of land use (measured by percentage of total area under cultivation). It must be stressed at once that with the possible exception of the boundary between the sugar belt and the interior these boundaries are rarely clear-cut; rather does each region merge into its neighbors to the accompaniment of a mingling of agricultural traits. These regions are seven in number: (1) The Northern Districts; (2) The Greytown Maize and Wattle Region; (3) The Foothills of the Drakensberg; (4) The Milk Belt; (5) The Sugar Belt; (6) The Pinetown Horticultural Region; and (7) The Weenen Region.

Graphs illustrating the general pattern of land use in typical districts in each of these regions are appended to the map; these show, in the following order: (a) percentage of farm area under cultivation, (b) percentage of crop area under cereals (mealies), (c) percentage of crop area under fodder crops, (d) percentage of crop area in sugar cane, (e) percentage of crop area under

horticultural crops, (f) percentage of farm area under wattle, (g) cattle density, (h) intensity of milk production, (i) density of sheep population.

The general land use features of each region are summarized in the following paragraphs:

1. *Northern Districts.* Essentially an area of extensive farming, characterized by a low percentage of total area under cultivation, a marked emphasis upon cereals (maize and kaffir corn over 75 per cent of crop area), and a low degree of importance for all other crops. Animal husbandry is oriented towards beef production, and milk output is small;

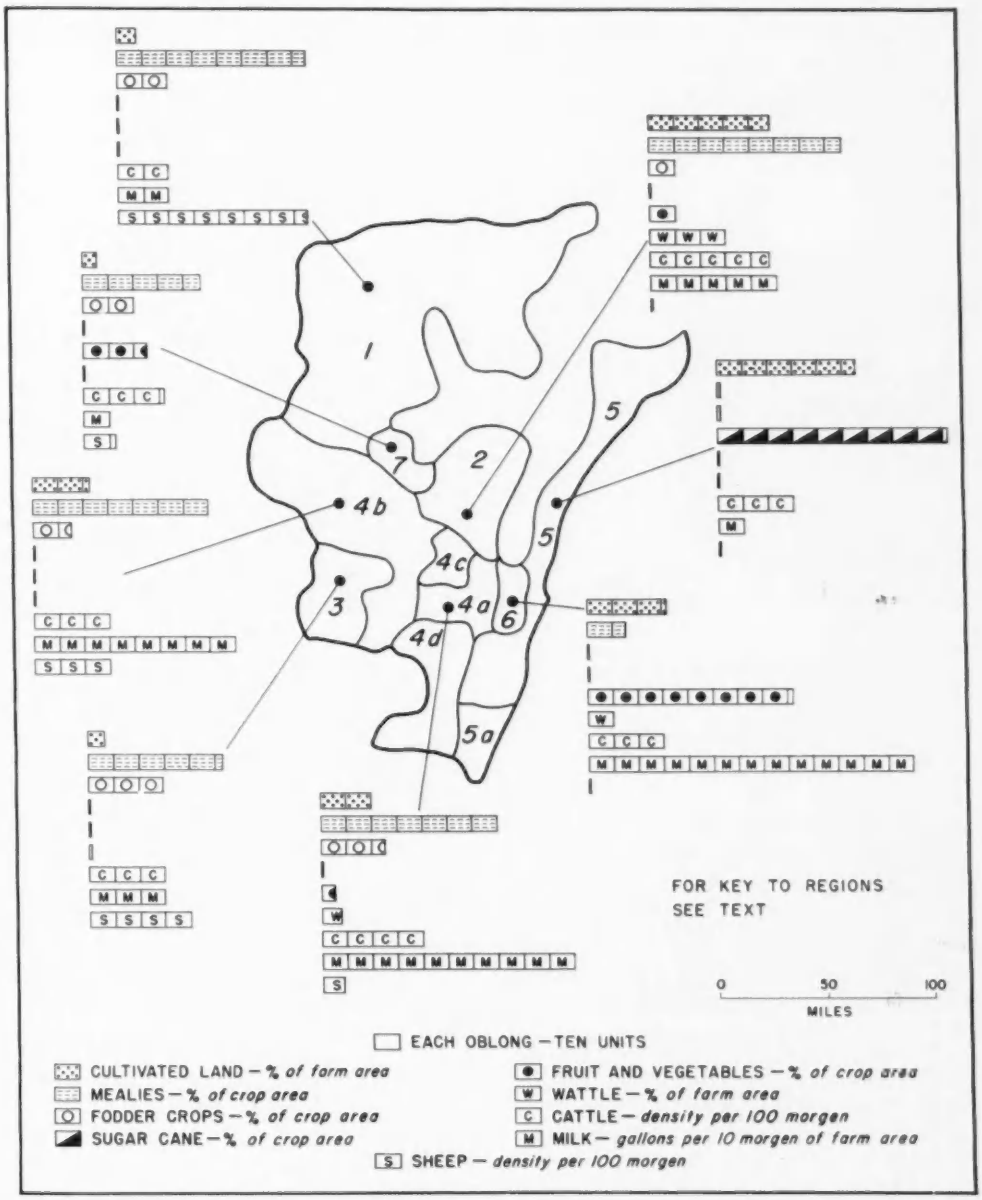


FIG. 15. Land use regions. A composite map somewhat generalized and based upon Figures 13 and 14. The regions are named and described in the text.

sheep are an important adjunct to beef production.

2. *The Greytown Maize and Wattle Region.* As the name suggests, the typical crops are maize (over 75 per cent of crop area) and wattle (over 10 per cent of farm area). The emphasis on maize suggests affinities with Region 1. The two regions are, however, differentiated clearly by the intensity of land use, the proportion of total area under cultivation in the Greytown region being some eight times that in the northern districts. The presence of vegetables, especially potatoes, as a subsidiary crop, the much higher cattle density (twice that of Region 1), the greater milk output, and the virtual absence of sheep are further differentiating features.

3. *The Foothills of the Drakensberg.* This region, centering upon the districts of Underberg and Impendhle, is conspicuous for the low intensity of most branches of production. Less than 5 per cent of the area is under cultivation. Maize occupies only slightly over one-half of the crop area and fodder crops are important, but cattle density is not remarkably high and milk production is

FIG. 16. European farm land on the rolling surface of the 2000-foot Platform. Category II land (as shown in Figure 3), with some Category I land on deeper-soiled river flats. Umgeni River, central Natal.

FIG. 17. The Humid Coast Belt. Sugar plantations north of Durban. Gently rolling country with easily worked soils and an adequate, well-distributed rainfall. Dominantly Category I with Category II on steeper slopes.

FIG. 18. Indian market gardens in the vicinity of the port city of Durban. In spite of the Province's flattering title of "The Garden Colony," fruit and vegetables are of only limited importance in Natal except in peri-urban areas. It is only natural that the greatest development should border Durban.

FIG. 19. Indian paddy fields in the vicinity of Pietermaritzburg. Rice is here close to its climatic limit.

low (300 gallons per 100 morgen). The density of the sheep population is higher than that of any other region in the south of the Province but is well below the density for Region 1.

4. *The Milk Belt.* This is divided into four subregions. Subregion 4a is the most highly developed sector of the Milk Belt. Dominant crops are maize (70 per cent) and fodder crops (25 per cent) with wattle and horticultural crops of subsidiary importance. Cattle density is high—35 to 40 per 100 morgen—and milk production is over 1000 gallons per 100 morgen. Subregion 4b is the area of lower dairying intensity, centering on Estcourt. Cattle density and milk output are only moderately high. Maize occupies approximately the same proportion of the crop areas as in 4a, but sheep density (30 per 100 acres) is five times as great. Subregion 4c is essentially the peri-urban area of Maritzburg. High intensity of milk production with fruit and vegetables of some importance. Subregion 4d, the southwestern sector, has a high proportion (over 75 per cent) of its crop area in maize and fodder crops are of reduced importance. Nevertheless, the production of milk remains high, especially in the north. In the extreme south, in Alfred District, wattle is an important element in the economy.

5. *The Sugar Belt.* This is distinguished by the high proportion of total area under cultivation (over 40 per cent) and by the complete dominance of sugar, which occupies some 95 per cent of the crop area in the center of the belt. Sheep are lacking, for climatic reasons; cattle density is moderate, but except in the immediate vicinity of Durban and Port Shepstone there is little milk production. In 5a the addition of fruit and wattle growing to the basic sugar economy suggests the separation of the area as a subregion.

6. *The Pinetown Horticultural Region.* Here the dominant feature of land use is the high proportion of land under horticultural crops. Four-fifths of the crop area is under subtropical fruits, especially bananas, and vegetables. Cattle density is moderate but, owing to the proximity of the urban market, milk production is high by Natal standards. Wattle forms a third important element in the economy of the area, wattle plantations occupying over one-tenth of the farm area.

7. *The Weenen Region.* This region shows certain unusual features. It combines a relatively low intensity of total land use (under 5 per cent total area under cultivation) with a high degree of specialization in its crops. Fodder crops occupy almost one-fifth of the crop area, but milk production is unimportant. Cereals occupy under one-half of the crop area whereas fruit,

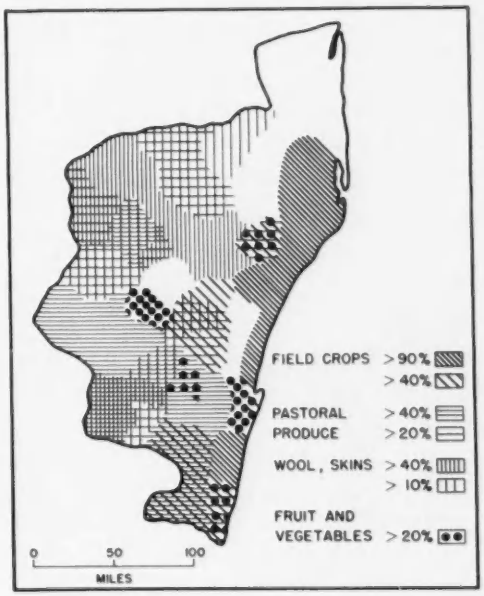


FIG. 20. Value of crops. A tentative map based upon estimated values for major agricultural commodities before World War II. Note the concentration upon field crops in the Coast Belt, on milk and associated products in the southern Midlands, and upon products of extensive animal husbandry in the northern districts.

vegetables, and potatoes together account for one-fourth of the crop area. Finally, of the cultivated area almost one-half is under irrigation. These features are sufficient to justify consideration of this area as a small but distinctive land use region.

CONCLUSION

The major points emerging from the foregoing paragraphs may be summarized under four heads:

Firstly, Natal is not over-generously endowed by nature with good farmlands and, faced with the prospect of a rapidly expanding population, maximum output in terms of food value is essential. The Province contains a wide diversity of geographic environments and a comprehensive program of research and mapping is essential if the potentialities of each are to be realized. The limited areas of good quality land occupy a critical place in any land use policy, since it is to these that the Province must look for a large proportion of the more exacting crops, especially fruit, vegetables, and milk. In this connection it is problematical how far the Province can continue to devote a very large proportion of its best land to a non-food crop such as wattle.

Secondly, except in the case of the Sugar Belt, closely tied to the high temperatures of the coast plain, and the mist-loving wattle, it is difficult to establish any close correlation between physical environment and land use pattern: the Milk Belt, for example, completely ignores rainfall boundaries and takes in humid and subhumid areas and a wide range of soil types. The dominating factor in the land use pattern appears to have been accessibility, largely to Durban, and it is possible to distinguish an approximately concentric zoning of production—horticulture, dairying, cereals, ranching—around this port city (Fig. 21). It would seem that a closer adjustment between the physical environment and farming practices is essential if the Province is to attain its maximum food output. To this end the rural areas of Natal need a vastly improved transport network which would make it economically practicable for each region to concentrate on the production of those crops and livestock products for which its environment is most suited.

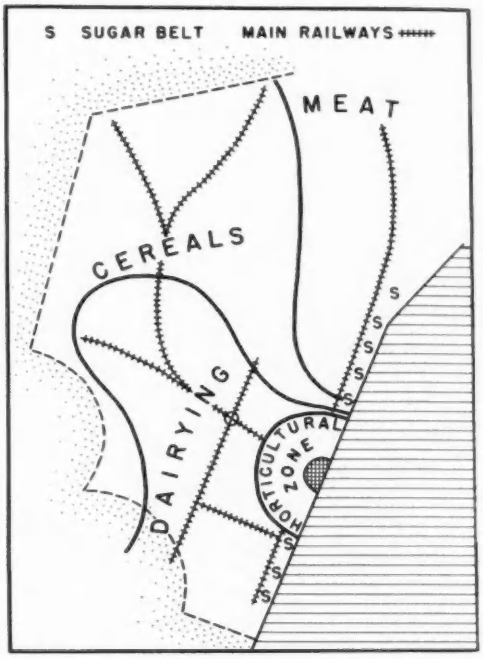


FIG. 21. Production zones. A highly generalized map illustrating the approximate concentric zoning around the port city of Durban.

Thirdly, the economy of the Province in the 1930's was characterized by an extreme lack of nutritional balance; it was essentially a carbohydrate economy with almost nine-tenths of its cropped area growing sugar or cereals, and with a completely inadequate production of protective foods—milk, vegetables, and fruit. Clearly, one of the first objectives of any agricultural policy for the

Province should be to correct this unbalance. The extent of the gap between production and needs may be gauged very approximately by comparing the prewar output of certain commodities with the estimated nutritional needs of the population (using the lowest dietary levels suggested by the Hot Springs Conference*):

(1) Milk. Fluid milk sold, 1936, 8 million gallons. Estimated requirements of urban population alone 18 million gallons.

(2) Eggs. Prewar production 2.25 million dozen. To provide for urban population alone at level suggested by Hot Springs experts (228 per person per year) production would have to be expanded 3¼ times.

(3) Figures for vegetable production are not sufficiently full to assess the gap between production and the nutritional needs of the population. Level of living studies, however, leave no doubt as to the very great under-consumption of vegetables among many sectors of the Natal population. In the case of root crops alone output should be increased 50 per cent to meet the needs of the urban population.

Finally, it must be emphasized that the population of the Province and hence food needs are expanding rapidly. Over the 1926–1936 intercensal period the average annual increment of population in the Province was 24,000. On the basis of the diet levels used above this means that the Province should aim at an increase of 1 million gallons of milk and 5 million eggs yearly, to take but two examples. Looking to the future, a doubling of the Province's population by the end of the century is not unlikely, and the agricultural problem of Natal becomes part of what is probably the greatest problem facing the world today: the problem of whether agricultural output can be expanded to keep pace with the present unprecedented upward surge in the world's population.

*United Nations Conference on Food and Agriculture, Hot Springs, Va., May 18–June 3, 1943.

THE BOLIVIAN TIN INDUSTRY

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BOLIVIA is one of the world's three principal tin-producing countries, normally exceeded in output by Malaya and in some years by Indonesia. Tin ranks first in value among the minerals mined and is the country's leading export.

Location

Adverse factors of location, which include the relatively isolated position of South America, the situation of land-locked Bolivia within the continent, and the location of the tin mining region within the country, are especially significant in the Bolivian tin industry. The tin zone is situated in the Bolivian Andean highlands. Thus all lines of communication must traverse mountainous terrain either to reach mainline railroads within the country or the west coast ports from which Bolivia's tin is shipped to world markets.

The major portion of the tin mining region is located in the western part of the mountain ranges known collectively as the Eastern Cordillera; there are also a few tin deposits in outlying hills along the western border of these mountains (see Fig. 1). The north-south extent of the area of active mining is from about the latitude of Lake Titicaca to a point not far from the Argentine border. The zone is narrowest in the north and gradually increases in width to the south. The present mining region may be divided into four districts: the Northern, which includes the group of mines northeast of La Paz; the North-Central, comprising the mines in the vicinity and to the northeast and southeast of Oruro; the South-Central, where Potosí and Porco are the leading producing centers; and the Southern, which includes those mines in the general vicinity of Uyuni. All mines are located at high altitudes, ranging from approximately 12,000 to 17,500 feet, and many of them are situated in extremely rugged terrain, frequently on the sides of steep-walled mountain valleys.

Physical Factors in Tin Mining

Arid climates prevail in the tin mining region. This fact alone precludes agriculture and thus limits the local food supply. Hydroelectric power is inadequate, and in some sites domestic and industrial water supplies are insufficient. Aridity also accounts for the fact that no large streams flow from the tin mining region to the sea to provide either water-ways or at least low passes through the mountains for highways and railroads.

In addition to dryness, the climate includes many other unfavorable features. Cold, storms, gale winds, snow, sleet, and ice add to the problems of utilization of the region. Winter storms frequently hinder transportation and

low temperatures in addition to drought prevent development of any significant agricultural industry.

Vegetation is sparse and consists chiefly of coarse grasses and low-growing shrubs, some of which are useful for fuel. Lack of trees necessitates importation of wood for mine timbers and for construction purposes.

The extremely high elevation and rarified atmosphere which prevail in the mining country affect man, beasts of burden, and machines. The population of the region has always been sparse, and the tin mining industry suffers from a chronic labor shortage. Only natives born and reared in the highlands can perform hard physical labor, and even native laborers are less efficient than comparable workers at lower altitudes. The efficiency of all machinery is reduced at high elevations. The llama is the only native beast of burden that is adapted to high altitudes and it cannot be used for heavy loads. Mules, whose death rate is high in elevated regions, must be used for such purposes.

The geology of the region is very complex. The tin ores occur primarily in vein or lode deposits; there are few known placers. The Eastern Cordillera is a great granite batholith covered with sedimentary and metamorphic rocks ranging in age from Silurian and Devonian in the north to Miocene or Pliocene in the south. There are some Cretaceous strata in its eastern ranges. Elevations are highest in the north (some peaks exceed 20,000 feet) and here, due to more active erosion, extreme dissection has taken place and the Tertiary granite core is widely exposed. Farther south the topography is somewhat more subdued and exposures of granite are extremely rare. Eruptions of acid magmas along north-south fracture lines and in anticlines followed

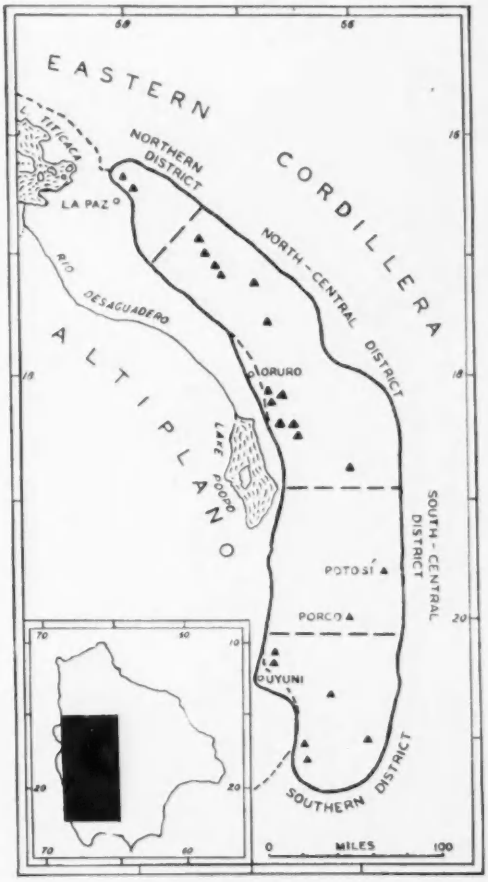

FIG. 1. The Bolivian Tin Mining Region. The boundary of the region is marked by a heavy line. Within the region the several districts are separated by broken straight lines, and within districts small triangles mark the location of principal tin mining centers.

Miocene or Pliocene folding and faulting. Tin ores are associated with these igneous intrusions. Adjacent hills, which contain deposits, are dacite or rhyolite stocks that were derived from the larger igneous masses in the ranges to the east. The section around Oruro, where there is particularly strong and deep fracturing, has experienced especially intense mineralization. This region produces about one-half of Bolivia's tin. The veins in the north are found in Tertiary porphyry dikes in the sedimentaries surrounding the granite core and closely associated with it. In the central and

FIG. 2. San José mine near Oruro, Bolivia. (Courtesy of Mrs. Helen B. Campbell.)

FIG. 3. Houses of native bosses at San José mine, Bolivia. (Courtesy of Mrs. Helen B. Campbell.)

southern portions numerous porphyry outcrops in the form of stocks, volcanic vents, and adjacent intruded sedimentaries contain tin bearing veins. Ores occur in fissure veins, brecciated zones, and crusted filling of cavities. Many other minerals of economic value are associated with the tin ores, notably silver, especially important in the south, bismuth, gold, lead, copper, and tungsten. There is considerable variation in tin content of the ores, ranging from 1 per cent to a high of 40 per cent, but averaging about 4 to 8 per cent.

PRODUCTION

Bolivian tin mining antedates recorded history. Bronze artifacts found in the ruins of pre-conquest Indian villages along the shores of Lake Titicaca confirm the antiquity of tin mining in the country. During the Spanish colonial regime and the early days of the Republic tin was neglected in favor of the more valuable precious metals, gold and silver, particularly the latter, which occurred in great abundance in the southern part of the

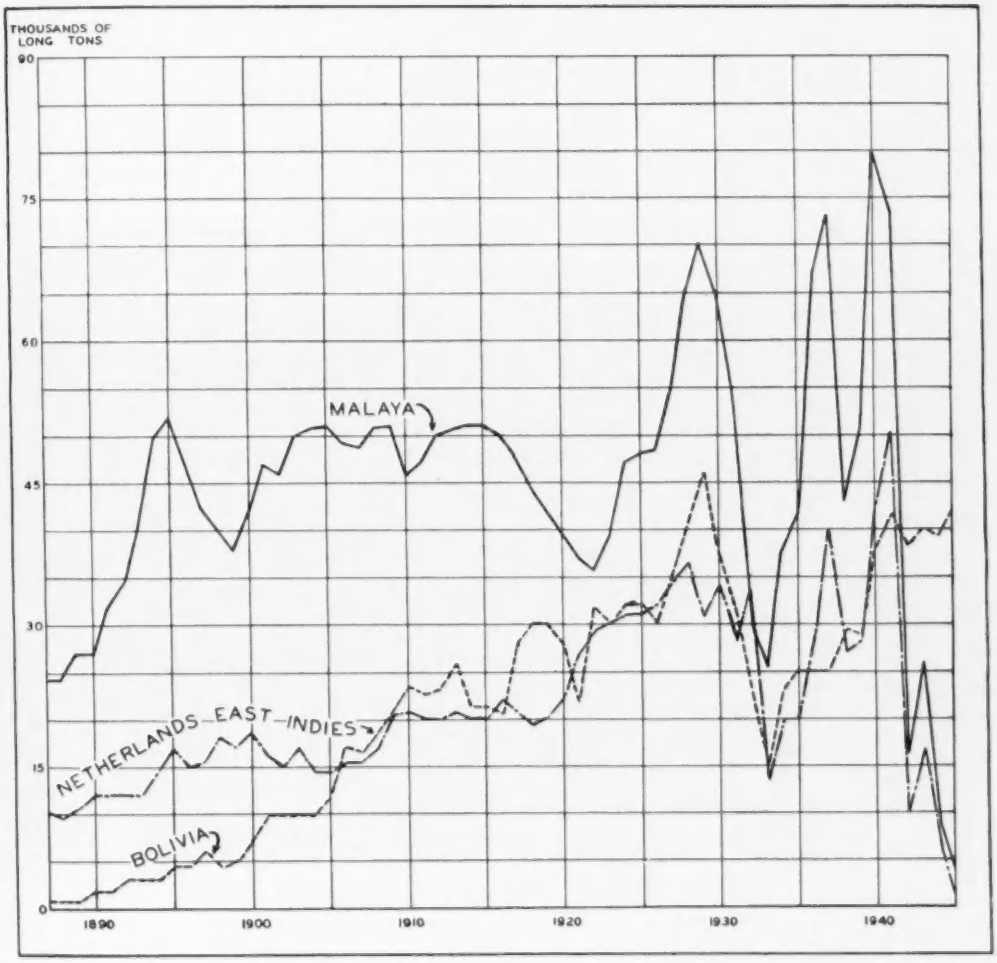

FIG. 4. Tin Production of Bolivia, Malaya, and Netherlands East Indies, 1887–1946. Note the great relative importance of Bolivia during World War II when other supplies were cut off. (Sources: U. S. Dept. of Comm. and U. S. Dept. of Int.)

mining zone. Exhaustion of Bolivia's richer silver ores, competition from silver mines in other parts of the world, a decline in silver prices, and increased demand for tin by a rapidly industrializing world coupled with exhaustion of European deposits brought about renewed interest in Bolivian tin near the end of the nineteenth century. As shortages of the metal occurred, prices rose and investors were attracted by the possibilities of large tin mining profits.

Tin output, which had been averaging about 100 long tons per year for several decades, reached approximately 300 tons per year in the 1870's and early 1800's; in 1887 almost 900 tons were extracted and subsequently there was a steady increase in production (see Fig. 4). By 1895 output was slightly more than 4000 tons and in 1900 nearly 7000 tons. Production continued to rise in the first two decades of the twentieth century, and in 1920 approximately 28 000 tons were extracted. During the late 1920's there was a rapid increase in output; over 46,000 tons were produced in 1929. During the early part of the depression in the 1930's many Bolivian mines were forced to close when operating costs exceeded profits, and output declined accordingly. Extraction rose again in 1934 as a result of higher prices for tin caused by the production control program put into operation by the International Tin Control Scheme. Expansion of output continued in the late 1930's, stimulated by preparations for the Second World War. During World War II, after the Far Eastern tin-producing nations had been occupied by Japan, Bolivia became the world's leading producer, accounting for amounts ranging from a low of 38,000 tons in 1942 to a high of 42,000 tons in 1945. At no time during this period, however, did Bolivian output exceed that of the country's peak year, 1929, in spite of unusually favorable prices and technical aid from the United States.

MINING AND MILLING PROCEDURES

Mining practices vary widely from pick and shovel methods in small mines to highly mechanized operations in large ones. Since practically all of Bolivia's ores occur in the form of lodes or veins, Bolivian mining is underground, hardrock mining and extraction methods must be adapted to the mode of occurrence of veins as well as to the financial status of the operators.

Milling processes vary considerably, depending both upon degree of mechanization and upon type of ore treated. The chief problem is to make a rich concentrate from low-grade and complex ores. Hand-operated and highly mechanized mills both produce a concentrate of about 60 per cent tin content, but the percentage of recovery for primitive mills is only about 50 whereas that of the modern mills is about 80. Furthermore, the concentrate produced by hand processes contains more objectionable impurities for which smelters impose penalties.

Gravity methods are most commonly employed for concentration, followed either by calcining to remove sulphur or by fine-grinding to prepare ores for elimination of sulphides by flotation.

LABOR

Scant supply and poor quality of labor is a serious problem with which the Bolivian tin mining industry has to contend. Since imported workers cannot be used because they are not adapted to physical labor in high altitudes, native Indians, Quéchuas and Aymarás, and Cholos (local name for the mestizo) are the mining industry's source of labor. Normally Indians

FIG. 5. Oruro, Bolivia. (Courtesy of Mrs. Helen B. Campbell.)

FIG. 6. Cholo women sorting tin ore at a Bolivian tin mine. (Courtesy of Mrs. Helen B. Campbell.)

perform the more menial and physically difficult work, whereas Cholos perform clerical and some minor administrative tasks. Uneducated, poorly nourished, addicted to excessive use of alcohol and to coca chewing, the Bolivian native has few of the attributes of efficient labor. Wages are low and labor troubles have been frequent in recent years.

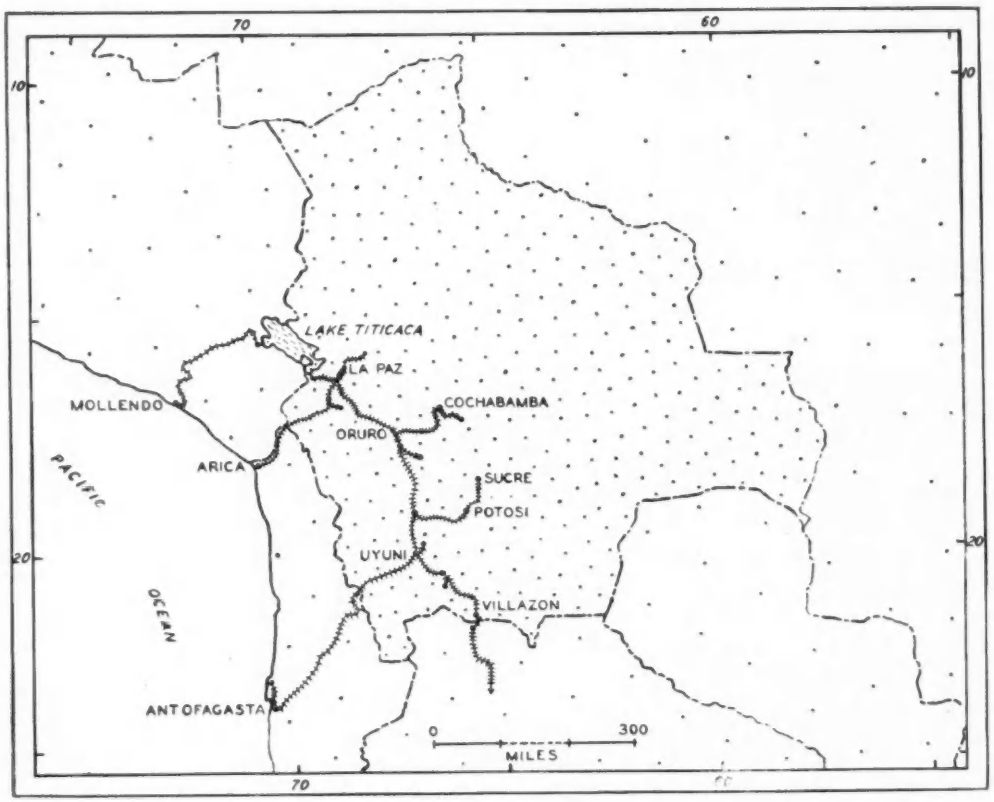

FIG. 7. Railways of Bolivia, 1948. The railroad pattern reflects the importance of mining which is concentrated in the highlands.

There is much controversy as to whether the poor quality of the work performed is due to the inadequate wages paid, or the quality of the work responsible for the fact that wages are so miserably low. Until the workers' social and economic standards are raised, the validity of the arguments in this controversy cannot be tested conclusively.

SMELTING

Tin smelting has never been a financial success in Bolivia. The various impurities in the ores make them difficult and expensive to smelt, especially when not mixed with purer alluvial tin such as that mined in southeastern Asia, and it would scarcely be economically feasible to ship such ores to Bolivia for this purpose. The country has no known deposits of industrial-grade coal and is also deficient in other fuels. Electric smelting is well suited to Bolivian ores and there is some available water-power. However, attempts so far to establish smelters using hydroelectricity have not been successful from the financial point of view. Con-

sequently, most of Bolivia's tin has been smelted in Europe, chiefly in the United Kingdom. During the two world wars and at the present time sizable quantities of Bolivian ores have been and are being smelted in the United States.

TRANSPORTATION

Transportation problems involved in mining and exporting Bolivian tin merit special attention. Bolivia is a land-locked country. Furthermore, high mountains, plateaus, and deserts separate the tin mining region from the sea. No navigable rivers connect the mining district with the coast. Railroads, trucks, and beasts of burden (llamas, mules, and burros) provide transportation. In mountainous terrain, such as that which obtains in the tin mining region and in the territory which lies between Bolivia and the sea, both highway and railroad construction, maintenance, and operation are excessively expensive, and hence freight rates must necessarily be high. Lack of coal and wood and inaccessibility of Bolivia's petroleum to the mining country necessitates utilization of expensive imported fuels which further increases freight rates. Nevertheless, Bolivian tin mining has developed progressively with the construction of the country's railroads and they have in turn received the major portion of their income from the exports and imports of the tin mining industry. These two facts are strikingly illustrated in the railroad pattern which is well developed only in and adjacent to the mining country and is wholly lacking or completely inadequate in sections of the country devoted exclusively to agriculture (see Fig. 7).

Expensive transportation jeopardizes the competitive position of Bolivia's tin mining industry. No other tin-producing country of importance has such difficult and costly transportation problems to contend with. Furthermore. Bolivian tin concentrates are shipped to world markets from ports which are on one of the world's less frequented trade routes and must travel long distances by sea to reach smelting and consuming countries. Tin smelting in Bolivia if it were feasible could alleviate this situation by reducing the amount of waste material upon which high freight rates must be paid and the tin could also then go direct to the consuming country rather than first to a country with smelting facilities and later to a consuming market.

Most of Bolivia's tin is shipped to the coast via the Antofagasta-Bolivia Railway which has its terminus at the port of Antofagasta, Chile. Smaller amounts are sent by rail to Arica, Chile, and Mollendo, Peru. Utilization of the Panama Canal since 1914 has shortened considerably the length of the sea route to the United States and Europe. Formerly tin was sent to these markets by the route around the southern tip of South America.

MINING COMPANIES

Bolivian tin mining is performed by private companies in which much foreign capital is invested. Most of the output is accounted for by three large mining interests, the Patiño, Hochschild, and Aramayo groups, which produce 75 to 80 per cent or more of the total Bolivian output. Smaller companies are divided into two groups: Medium and Small Mines, the latter controlled and aided to a considerable extent by the Bolivian Mineral Bank (Banco Minero) through whom they are required by law to market all of their tin. Members of the Medium group may also sell their tin through the Mineral Bank but it is not compulsory.

The Banco Minero was organized in 1937 and, in addition to marketing the

product of the Small Mines, it has furnished considerable aid in the form of loans by acting as a group purchasing agent and through various technical services rendered to these smaller operators.

Of the big three, Patiño has been the most spectacular operator and has accounted for almost 50 per cent of Bolivia's tin output, thus definitely dominating the country's tin mining industry. Hochschild and Aramayo production accounts for some 37 per cent (Hochschild about 27 per cent and Aramayo 10 per cent in recent years).

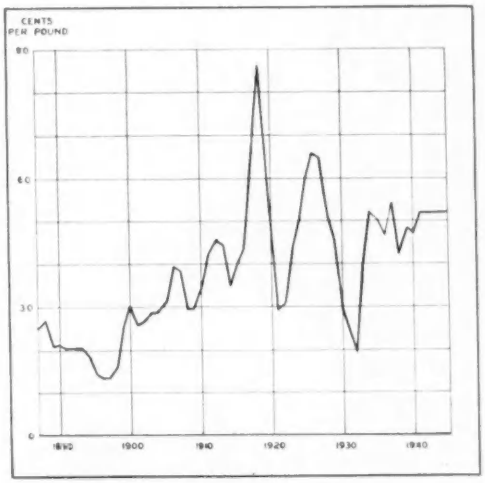

FIG. 8. Average New York price for tin, 1887–1945. (Sources: U. S. Dept. of Int., U. S. Dept. of Comm., and K. E. Knorr, "Tin Under Control.")

PRICE STRUCTURE

Advances and retrogressions in Bolivia's tin mining industry show a very close relationship to tin prices in world markets. The amount of tin utilized in the United States has a marked effect upon the world price structure of tin. The United States is the world's chief tin-consuming country, utilizing some 50 per cent of the total output. Thus the degree of industrial activity in this country and its demand for tin are significant factors in determining tin values.

Wars and depressions with their consequent effect upon demand for tin account for most of the major fluctuations in world tin prices (see Fig. 8). Between 1887 and 1910 the average annual price of tin per pound in New York ranged from a low of 13.3 cents to a high of 39.8 cents. The lowest price during this period resulted from a depression in the United States in the 1890's. In 1911 tin reached an average price of 42.3 cents per pound for the year in New York and a high of 86.8 cents was attained in 1918. This rapid rise in prices was caused by increased demand for tin and its scarcity during the First World War. The depression in the early 1920's in the United States caused tin prices to drop to an average of 29.9 cents per pound in 1921. Business recovery and rising tin prices paralleled each other throughout most of the postwar boom. Overproduction, however, caused tin prices to drop in 1927, two years before the end of the boom, and they continued downward through the early 1930's.

Since 1931 tin prices determined solely by normal supply and demand have ceased to exist. World tin-producers became alarmed at the rapid decline in prices and demand in the early years of the depression and they came to the conclusion that limitation of output and creation of an artificial tin shortage were the only methods by which much of the tin mining industry could be kept solvent. Accordingly in 1931, after several previous attempts to raise prices by means of pools and voluntary production curtailment had failed, an international production control program, the International Tin Control Scheme, was initiated. This organization was formed by the governments of four of the world's principal tin produc-

ing countries, Malaya, Indonesia, Nigeria, and Bolivia, and later joined by others. It was administered by the International Tin Committee. This scheme was radically different from all previous control plans in that it was entered into by the governments of the nations concerned and production curtailment was enforced by law in each country. The International Tin Control Scheme had several advantages. There was a high degree of financial integration among both the tin mining and smelting industries, there was little secondary recovery to compete with virgin tin, and few substitutes for the metal existed. Furthermore, there was a marked separation between producing and consuming countries, and, of great importance, most of the production was concentrated in countries controlled by only three governments, the British Empire, the Netherlands, and Bolivia. All of the local governments in these countries were highly dependent upon income derived from tin and, therefore, intensely interested in the success of the scheme. Price recovery was slow, but gradually a shortage of the metal was achieved and prices began to rise.

The tin scheme was renewed a second, a third, and a fourth time. Pools to remove surpluses from the market augmented the effects of the International Tin Control Scheme. By the time the third agreement became effective preparation for the pending Second World War had begun to affect the market and by 1939 demand was so great and prices had risen so high that the need for the cartel was no longer apparent. In 1941 free world tin prices became virtually non-existent when both the United States and British governments established ceiling prices and assumed control over all purchases and sales of the metal within their domains. During the War the chief problem was one of supply and not of price, as demand constantly exceeded the available amount of tin. A fourth control scheme was agreed upon in 1942, although at this time its only useful purpose was to perpetuate the organization. Tin prices have risen since the conclusion of the War and until the Far Eastern mining regions are completely rehabilitated scarcity of tin will continue to insure a high price for the metal.

ROLE OF TIN IN THE BOLIVIAN ECONOMY

Since the early part of the sixteenth century Bolivia has had a dual type of economy, one phase based upon subsistence agriculture and currently supporting from one-half to two-thirds of the population and the other a commercial economy based upon mining and export of mineral products. Until shortly before the beginning of the twentieth century silver was the most important mineral extracted; subsequently tin has replaced silver as the chief product of Bolivia's mines.

Bolivia's commercial economy is of a colonial type, characterized by extraction and export of primary raw materials, the income from which has in turn been utilized to purchase foods, raw materials, manufactured goods, and fuels from abroad. Manufacturing enterprises are not sufficiently developed to seriously challenge the position of the mining industry and the economic phase of Bolivia's agricultural activities is minor. In the twentieth century minerals have always accounted for more than 80 per cent of the total value of the country's exports and have been as high as 96.8 per cent (see Fig. 9). Tin has been the principal export mineral, always accounting for at least 60 per cent of the total value of exports and usually 70 per cent or more. Thus minerals and especially tin are a vital source of

Bolivian foreign credit and since the country is not self-sufficient even in basic foods it cannot exist without foreign exchange to supply necessities as well as luxuries. Bolivian imports, paid for by sales of tin and other minerals, include such essential items as wheat, flour, rice, sugar, cotton cloth, fuels, and even many of the raw materials utilized by the country's small manufacturing industry. Thus, an even lower standard of living than that which exists today would obtain were it not for the income derived from tin.

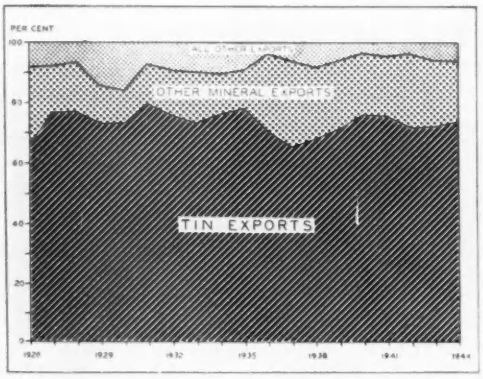

FIG. 9. Bolivian exports, 1926–1944, show the continued dominance of tin. (Data from U. S. Dept. of Comm.)

There is, however, another aspect to Bolivia's mineral-based economy. An almost complete dependence upon tin has produced a dangerously unbalanced economy. The financial prosperity of the country and the strength of the Government depend upon the fortunes of tin in world markets, the demand for the metal, and the price obtained for it. When the tin industry is not prosperous, Bolivia suffers from financial crises.

Bolivia's reliance upon tin is very precarious, chiefly because most of the world's other leading tin-mining countries produce the metal more cheaply than does Bolivia and, therefore, can continue to market tin at a profit when Bolivia is unable to do so. Another reason why Bolivia is especially vulnerable in its dependence upon tin is that substitutes for it have been developed which may lessen future demand. Changes in manufacturing technology have also decreased the amount of the metal required in many of the products containing tin. When tin prices are high these two factors cause a decrease in demand for the metal, thereby affecting the Bolivian economy even in times of seeming prosperity in the tin industry.

As a result of the large and quick returns that have been obtained from tin mining, Bolivia has failed to develop adequately its many other resources, so that the country has no other significant source of income to supplement or replace that derived from tin when that industry is not prospering. Thus, an unbalanced commercial development of the country as a whole has resulted, some sections having been developed whereas others have been neglected. Agriculture and manufacturing are both basic to a well rounded economy; Bolivia has neglected both in favor of mining. Many of the products that might be manufactured in the country as well as foods that could be grown locally are obtained from abroad.

An economy based upon a mineral is a transitory one, all minerals are exhaustible resources and all mining industries are eventually self-liquidating. Conservation procedures may prolong the life of a mine, but they cannot replace the ores after they have been extracted.

Tin mining has caused a concentration of transportation facilities in one part of the country, which has retarded exploitation of resources in those sections of Bolivia, which, as a result, lack such facilities. When the tin deposits are exhausted, the location of some of the railroads will be useless for other

industries because the present mining region offers no other means of support for the Bolivian people.

Bolivian exports, other than tin, are in some cases only possible because of joint use of the tin-supported railways. This applies particularly to some of the other minerals obtained in the tin mining region; the prosperity of these other mining enterprises is dependent upon tin. More adequate development of the country's resources would contribute to the income of the railroads so when tin exports are small the railroads might better be able to remain solvent.

Many of Bolivia's larger cities are located in and adjacent to the mining country. There is every likelihood that they will become ghost towns when the tin deposits are depleted, as did Oruro and Potosí when their richer silver ores had been exhausted. These cities, like some of the railroads, are located where it is not possible to develop other types of occupations.

A few Bolivian families and foreign investors own essentially all of the important tin mining properties of the nation, and profits from the tin industry benefit only a very small number of the Bolivians plus a few foreigners. Furthermore, mining activities employ relatively few people, especially where a high degree of mechanization has been attained, so Bolivia's best developed industry is not able to support a very large percentage of the country's population. Some 40,000 miners are employed by the industry but their wages are too pitifully low to maintain a fair standard of living. In some of the mining camps living and working conditions are no better than on the most primitive subsistence farms. If the tin mining industry cannot raise the standard of living of its workers, it can scarcely be called beneficial to them.

It has been only in recent years that the Bolivian Government has derived a substantial portion of its income directly from the tin industry. Previously, the greater part of the Government's revenue was obtained from taxes on imports, rather than on exports. Indirectly, however, the Government had profited by the sale of tin because such sales abroad provided the foreign exchange with which imports were purchased. There is grave danger, now that Bolivia has begun to tax the mining

FIG. 10. Pay day at a Bolivian tin mine. Cholo women waiting to sell their wares to the tin miners. (Courtesy of Mrs. Helen B. Campbell.)

industry more heavily, that these taxes may become too oppressive and prevent the Bolivian tin mining industry from being able to compete with lower-cost producers elsewhere whose taxes are also lower. For example, recent Bolivian taxes on tin have been greater than the total cost of tin production in

some of the Malayan mining districts.

Taxes on tin have produced a notable increase in Government revenues. By using at least a portion of this income it should now be possible for Bolivia to develop its other resources and other sections of the country. If such a program were put into effect, many more Bolivians could derive benefit from the exploitation of this valuable national asset.

Bolivia's situation will be most unfortunate when its tin ores have been exhausted if the country has failed in the meantime to develop other national resources. It may be too late for Bolivia itself to exploit these other resources when the income from tin, which the national treasury has been receiving, is no longer forthcoming. This would force Bolivia to rely upon investments of foreign capital to exploit its neglected resources, a very unsatisfactory solution at best with all of the possibilities for political and economic friction that frequently arise when a state is dependent to a large degree upon capital investments from abroad.

THE CARSON AND COLORADO RAILROAD

John F. Due

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THE period between 1870 and 1890 was characterized by the development of numerous projects of railroad construction throughout the West, which, had they been carried to completion, would have blanketed most of the area with as complete a network of railroads as that of present-day Illinois. But only a small proportion of these, except the projects connecting the larger cities, ever progressed beyond the planning stage. Shortage of capital, more than any other single factor, prevented their realization. Of the few projects in the thinly settled areas that were actually carried out, one of the most extensive, and in many respects one of the strangest, was the construction of the Carson and Colorado Railroad, built during the early 1880's for 300 miles across the desert valleys and mountains of central-western Nevada and southeastern California. On the entire line no community contained as many as a thousand inhabitants; only four had populations of more than 100. In the year construction was undertaken —1880—the rail network of the West had hardly been started (Fig. 1). The Pacific Northwest had no rail connection either with California or the East. The coast line between San Francisco and Los Angeles had not been built; no line connected Texas and southern California.

The Development of the Project

The Carson and Colorado was the offspring of the Virginia and Truckee Railroad, built during the period between 1869 and 1871 to connect Virginia City, the center of Nevada mining activity during the sixties and seventies, with the Central Pacific at Reno. Virginia City, with close to 10,000 residents, was the largest city between Sacramento and Salt Lake City. Its location—high on the slopes of Mt. Davidson in the Virginia Range southwest of Reno—prevented the construction of the main line of the Central Pacific through it. But the need for a railroad into the city was great, not only for the handling of through freight, but also for the movement of ore from the mines to the mills in the Carson Valley and of lumber from valley points to the mines. Accordingly, the Bank of California group, owner of several of the principal mines, mills, lumber enterprises, and other industries in the area, undertook the construction of the Virginia and Truckee Railroad from Virginia City via Carson City to Reno. The line was financed, except for some aid from Ormsby and Storey Counties, entirely by the three leaders of the Bank group: D. O. Mills, pioneer Sacramento banker, and one of the wealthiest men on the Coast; William Ralston, Cashier of the Bank of California, and San Francisco's outstanding business promoter of the period; and William Sharon, the Bank's representative in Virginia City, who later became the active leader of the group after Ralston's death in 1876. The first great boom of the Comstock

Lode was over before construction was started, but the road was completed in time to reap full benefit from the great discoveries of the seventies, even though the bonanza mines of this period were those of the Mackay-Flood group, bitter adversaries of William Sharon and his associates. The 50-mile line was extremely profitable; for example in 1878 net operating profit was $725,000, and dividends of $750,000 were paid;[1] the original investment did not exceed $5,000,000 and probably was much less. The success of this road, coupled with the relative unprofitability of the Bank's Virginia City mines during the seventies, led the Bank group to consider the possibility of additional railroad construction, in order to find profitable investment for the large sums of capital which the leaders had in their possession.

The area to the south of that served

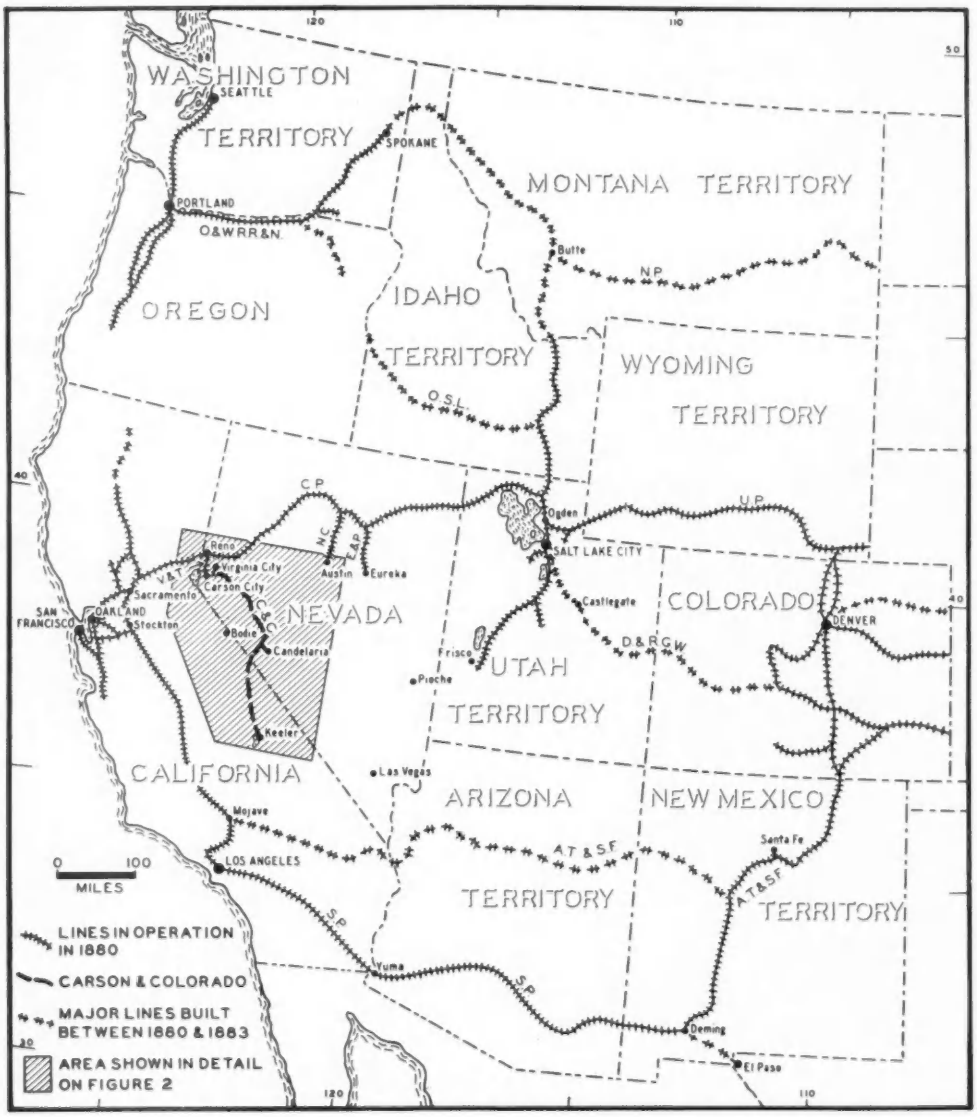

FIG. 1. Extent of the railroad network in Rocky Mountain and Pacific Coast states in 1880, and major construction, 1880–1883.

by the Virginia and Truckee was a land of barren, thinly-wooded mountains, separated by dry sandy valleys (see Fig. 2). In the northern portion of the region the Carson River and the East and West Walker Rivers flowed eastward from the Sierras to provide a limited supply of water. The Carson

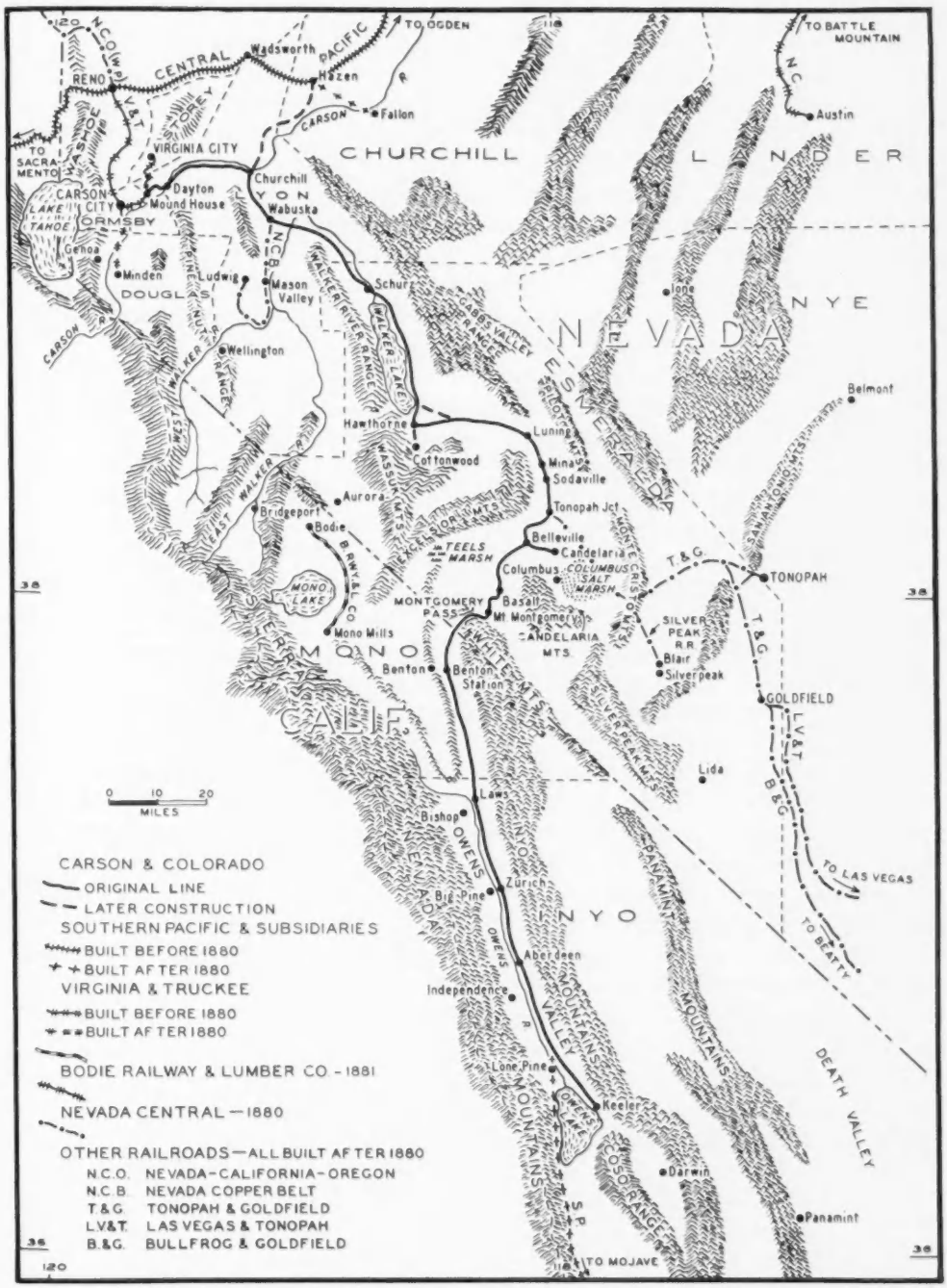

FIG. 2. Carson and Colorado Railroad and other railroads in west-central Nevada and the Owens Valley region of California (Cf. Fig. 1).

flowed into Carson Sink 40 miles east of Carson City. The two Walker Rivers, after joining in the Mason Valley, flowed south and emptied into Walker Lake, a sheet of water 20 miles in length lying at the foot of the abrupt eastern slope of the Walker River Range. South of the Walker River, the Excelsior, Candelaria, White, and Inyo Ranges blocked the eastward flow of water from the Sierras; the streams from the latter flowed southward down the Owens Valley, and were lost in Owens Lake. Accordingly, the territory east of these ranges, with very scanty rainfall, was extremely dry.

Much of the region was uninhabited. The three Nevada counties in the region—Lyon, Nye, and Esmeralda (the latter of which consisted until 1911 of the area now comprising Esmeralda and Mineral Counties)—contained 7504 inhabitants in 1880.[2] But a considerable portion of this total lived in the extreme north portion of Lyon County, close to Carson City, and in parts of Nye County located closer to Austin than to any railroad line that might be built south from the Carson City area. The California portion of the area, Mono and Inyo Counties, contained 10,427 inhabitants. The population of the region depended upon scattered mining developments, and upon limited cattle raising and farming. No discoveries of ore had been made comparable to those in Virginia City; the discovery at Aurora, which first led people into the area, had lasted only until the middle of the decade of the sixties. Most of the land was unfit for agriculture because of lack of water.

Despite the limited traffic potentialities, however, construction of railroads into the area had been planned since the early 1860's. The first session of the Nevada legislature in 1864 granted a charter to the Esmeralda and Walker River Railroad, projected to Aurora, but no construction was undertaken. In 1873, J. P. Jones, Virginia City mine superintendent who had become wealthy almost overnight as a result of the Crown Point bonanza, planned a line into the Owens Valley from Santa Monica, which he was attempting to develop into a major port. In the early part of 1880 a survey was made by the Western Nevada Railroad Company for a line extending from Wadsworth, on the Central Pacific east of Reno, to Candelaria. Likewise during the same period a project was developed for a road from Bodie to Reno, and for one from Stockton, California, across the Sierras to Bodie. None of these plans materialized. But also in the spring of 1880, the Mills-Sharon group became interested in a line into the area. On May 10, the Carson and Colorado Railroad Company was incorporated, with Henry M. Yerington as president. Yerington, who had been associated with the Sharon group for several years, was superintendent of the Virginia and Truckee, and had extensive lumber interests in the Lake Tahoe region. The line was projected southward from a connection with the Virginia and Truckee. As explained later, the final destination which the promoters had in mind is not known; it is doubtful if they were certain themselves at the time.

In the region to be served immediately, there were four principal sources of anticipated traffic:

1. The silver mines at Candelaria, located in the barren ridge, sometimes called the Candelaria Mountains, which connects the White and Excelsior Mountains. The dry, rocky site, about 175 miles south of Carson City, was one of the most inhospitable of all Nevada mining camp locations. Ore had been discovered in the region as early as

1864, but significant production did not occur until the development of the Northern Belle mine in 1876. Reduction mills for the ore had been located at Belleville, seven miles northwest, because of the availability of water. In 1880 the population of Candelaria was 756, that of Belleville, 380. Total revenue of the mines in 1880 was $1,153,426.[3]

2. The silver mines at Bodie. Forty miles west of the southern tip of Walker Lake, and just across the California border, was the newly developed mining area of Bodie, the most active producing area in the entire region. The 1880 census showed a population of 2712. Although construction of the line directly to Bodie was not contemplated, it was expected that the locality would provide substantial traffic, reshipped from the nearest rail point by wagon. The expected importance of the Bodie traffic is indicated by the early advertisements of the company, which described the line as the "new rail route to Bodie."

3. The salt and borax deposits in the Columbus Valley, between the Monte Christo, Candelaria, and Silver Peak Mountains, and at Teels Marsh, southeast of the main Excelsior range. Previous attempts to develop the deposits had failed primarily because of transportation difficulties; both areas would be close to the line, and would offer definite traffic potentialities.

4. The agricultural developments in the Mason Valley. This region, supplied with water from the Walker Rivers, had been settled during the 1860's.

CONSTRUCTION TO CANDELARIA

The first unit constructed and placed in operation was the line from the connection with the Virginia and Truckee to a point at the south end of Walker Lake (Hawthorne), from which Bodie was reached by wagon and stage coach. Prior to this time the main wagon road from Carson City to Bodie followed a route via Genoa, Wellington, and Aurora, rather than via Walker Lake. Construction was carried on by a company separate from the railroad, but owned by the railroad promoters. All payments to the contracting firm were made in the bonds and stock of the railroad company. At the northern end, work was started with white labor, because of the strong anti-Chinese sentiment in Virginia City. Following a strike, however, designed to raise wages from $1 a day and board to $1.50 a day, white workers were replaced by Chinese. The latter were used from the start on the southern portion of the line.

Construction was actually started in the summer of 1880. The Virginia and Truckee main line ran directly east out of Carson City across the eastern projection of Eagle Valley to Empire, followed the Carson River for several miles past the mills which handled Virginia City ore, and then turned abruptly north across the narrow valley before starting the ten-mile climb to Virginia City. In the flat of this valley, at the station of Mound House, the Carson and Colorado was started. It wound down through a gap in a low ridge to Dayton, a town of 391 inhabitants, many of whom were employees of the Carson River mills. The track crossed the river, and followed the open canyon eastward for about 20 miles, to the point (Churchill) at which the river turned northward to enter Carson Sink. At Churchill the line turned southward, and running on almost level grade passed into the northeast corner of the Mason Valley. A station was erected at Wabuska to serve the town of Mason Valley (now Yerington) 12 miles to the south, and the agricultural interests of the valley. The line swung eastward from Wabuska,

and followed the Walker River through desert hills to Schurz, where it came out onto one of the ancient shorelines of Walker Lake. For the next 20 miles the track followed the even grade on the east side of the lake; no grading was necessary, and the gravel of the shore provided natural ballast. At the south end of the lake, the railroad turned west, and descended to the floor of Lake Valley. In the sand-covered flat a few miles south of the lake the townsite of Hawthorne was laid out in April of 1881, to serve as the junction point for the freighting of goods to Bodie. Shops were built by the railroad, and operation and maintenance controlled from this point, although the general offices of the company remained in Carson City.

The townsite was developed by a company owned by the railroad officials. The first passenger train on the new line was an excursion train run from Mound House, to show the new townsite to residents of Carson City and Virginia City who might be induced to settle in it. The reactions of the visitors was mixed; the sandy plain did not impress many of them as a very desirable place in which to live. But nevertheless the town grew; it replaced Aurora as the county seat of Esmeralda county in 1883. A wagon road was built westward over the mountains to Bodie to facilitate freighting; the company indicated that the road would eventually be replaced by a railroad if sufficient business developed. Actually of course Bodie was nearing the end of its prosperity.

Construction was pushed southward toward Candelaria in the summer of 1881. The line climbed a grade out of the lake flats, swung due east to avoid the ridge directly south of Hawthorne, and after passing through the very sandy gap between the Excelsior and Gabbs Valley Mountains, entered Soda Springs Valley, and turned south again at Luning. After descending a slight grade, the line reached Soda Springs (later known as Sodaville), which 20 years later became the transfer point for Tonopah and Goldfield freight. A few miles beyond Soda Springs the road turned to the west, left the valley (Excelsior Flat) which opened to the south onto the Columbus salt marsh, and after climbing the alluvial fans on the west slope of the Candelaria Mountains, reached Belleville, situated in a canyon in the hills, on December 31, 1881. Belleville was the first existing town which the line had reached since Dayton, 150 miles to the north.

In the next two months the line progressed up the dry canyon, curved sharply south up a steep rocky slope, passed over a long wooden trestle, and crossed through a gap in the ridge into, or rather directly above, Candelaria, which was located in a gulch on the south side of the ridge. The residents of the town greeted the line with the usual celebration when the first train arrived in March of 1882.[4] This was apparently the only place in which the construction of the Carson and Colorado was responsible for a celebration of the type which characterized the completion of railroad lines in all parts of the country during this period. Regular freight and passenger service was established at once; the *Bodie and Candelaria Express* left Mound House at 9:30 A.M. daily after receiving passengers from the Virginia and Truckee's early morning train from Reno, and reached Candelaria at 8 P.M. The stage connection from Hawthorne arrived in Bodie at 10 P.M.

EXTENSION INTO THE OWENS VALLEY

As indicated above, when the line was started, it is doubtful if the owners had

very definite plans in regard to the extension of the line beyond Candelaria. Most statements of the officials of the road during 1880 referred to Bodie and Candelaria as the objectives of the road. The only exception was a statement in the Virginia City *Evening Chronicle* which quoted President Yerington as stating that the line would be extended eventually to "a point in Colorado." It is probable, however, that the reporter misunderstood Yerington, as there is no other evidence that Colorado was an objective; it was generally understood that the word *Colorado* in the company's title referred to the river of that name. One of the first maps of the proposed line, appearing in an advertisement in the Virginia City *Evening Chronicle* (April 9, 1881), showed the road extending in a southeasterly direction from Candelaria, through the mining camps of Silver Peak and Lida, and ending in the desert south of the latter town. A map in a prospectus of the California and Nevada Railroad, being promoted during this period between Oakland and Bodie, showed two projected Carson and Colorado lines extending from Candelaria, one southeastward to Callville on the Colorado River, and the other down the Owens Valley to Mojave. Such maps are of course notoriously inaccurate.

Regardless of the original intentions, the Carson and Colorado management announced shortly after the line reached Candelaria that the railroad would be built across Montgomery Pass into the Owens Valley, which lies between the Sierras and the Inyo-White Ranges. The immediate objective was Keeler, a small settlement on the east side of Owens Lake, about 100 miles down the valley. The main sources of anticipated traffic from the extension were four:

1. The mining districts in the Inyo Mountains east of Owens Lake. Panamint (located in the Panamint Mountains, east of the Inyo Range, and directly west of Death Valley), after a great boom which had lasted only a few years, had ceased to produce by 1877. But the Cerro Gordo mine a few miles east of Keeler was still an active producer, although it had passed its days of peak production. Twenty miles southeast of Keeler the Darwin area was producing substantial quantities of ore. Both of these districts were lead-silver-zinc producers. From Cerro Gordo the ore had previously been carried by steamer across Owens Lake, and thence by wagon to Los Angeles or Mojave. There were also some

FIG. 3 (left). Central part of Owens Valley, looking toward Big Pine; the Sierras in the background.

FIG. 4 (right). Grade of the Carson and Colorado descending Montgomery Pass on the south side. Service was discontinued on this portion of the line in 1937.

mining developments farther north in the valley, especially in the hills around Benton.

2. The soda and potash deposits of Owens Lake.

3. The agricultural communities of the Owens Valley. The use of this valley as an emigrant route to the San Joaquin Valley had led to its settlement in the early sixties, long before many regions of California which were closer to the more densely populated areas. Water from the Sierras allowed cattle raising and grain production.

4. Interchange traffic from the new line of the Southern Pacific at Mojave, should the Carson and Colorado be extended to that point. This Southern Pacific line, built down the San Joaquin Valley from San Francisco to Mojave, and thence eastward to a connection with the Santa Fe at Deming, New Mexico, was the second transcontinental route completed. In 1882, a connection was built between the line and the Texas and Pacific at El Paso. The narrow gauge of the Carson and Colorado would have prevented its use as a through route, but some traffic would undoubtedly have moved into and out of the territory via Mojave. The Carson and Colorado management also apparently had in mind the widening of the gauge if significant potentialities for through traffic developed. But it was undoubtedly clear to them that so long as the Central Pacific and the Southern Pacific were under common management, these lines were not likely to encourage routing of southern California traffic via the Carson and Colorado at the expense of their own line via Sacramento and Reno.

Two new corporations were formed to build the extension, the Carson and Colorado Railroad, Second Division, which built to the California border, and the Carson and Colorado Railroad, Third Division, which built from the border to Keeler. Both were wholly owned by the parent company, and the trackage operated by the latter under lease. In the late spring of 1882, construction was resumed; the extension branched off the existing line near Belleville at the point (later called Filben) at which the line swung south to climb the divide to Candelaria. The extension climbed at first through fairly open country which opened to the north toward Teels Marsh, then passed through a narrow, rocky canyon, and emerged onto a plateau in the vicinity of Basalt. From this flat began the final climb, on a winding, 3 per cent grade, to the summit of Montgomery Pass. The latter, with an elevation of 7138 feet, is higher than the Southern Pacific's crossing of the Sierras at Donner Summit, even though it merely crosses the ridge which connects the White and Excelsior Mountains. A few miles south of the pass is Boundary Peak, 13,145 feet in elevation, the highest point in Nevada.

The descent of the pass on the south was made on a 3.2 per cent grade, with several horseshoe curves, and numerous deep cuts and extensive fills (Fig. 4). A 247-foot tunnel carried the track through one spur of the mountains. The rapid descent brought the line to the floor of the Benton Valley, the extreme northeast projection of the Owens Valley. A few miles south of the foot of the pass, Benton Station was established to serve Benton, a mining community in the hills four miles to the west. South of this station, the track dropped abruptly in a winding course from Benton Valley to Hammil Valley, and then straightened again on a gradual descent to Laws, at which point it entered the Owens Valley proper. A station was erected at Laws to serve Bishop, a farming community of several

hundred persons located on the west side of the valley.

The remaining 70 miles of track, almost straight and level, ran southeastward down the east side of the long, narrow Owens Valley to Keeler. As a result of the use of the east side route, the line did not pass through a single town between Belleville and Keeler. Despite all efforts of the farm communities on the west side of the valley—Bishop, Big Pine, Independence, and Lone Pine—the east side route was adopted, apparently primarily for topographical reasons. The west side was cut by small streams from the Sierras; the east side was much more level. Also, the railroad management apparently believed that the farm community business would be available to the road despite the four to six mile wagon haul from the east side stations, whereas some mining traffic from the east side might be lost if the other route were used. The failure to reach the towns did not increase the popularity of the road with the residents of the area, however. Eventually a line was graded from Laws to Bishop, but no rails were ever laid. The railroad management also talked for a time of a branch from Benton Station to Benton, but this likewise was never built.

The track reached Benton Station in January, 1883, and Keeler in August of the same year. The rapid progress in construction of the Carson and Colorado contrasts sharply with the slow pace of construction of many other lines during the period. For example, the Nevada and California (later the Nevada-California-Oregon), started northward from Reno in 1883, but hampered by lack of capital, did not reach Alturas, 176 miles from Reno, until 1908.

As soon as the Carson and Colorado reached Keeler, plans were made to extend it to Mojave, 120 miles to the south, in order to connect with the Southern Pacific. Surveys were made; the *Railway Gazette* carried several notations during the middle eighties that the road would be continued south in the near future. But construction was never actually started; the relative unprofitability of the road after 1883, the decline of mining in the area, and the lack of interest in the road by Mills, the chief source of capital, resulted in failure to undertake the extension. After Mills had completed his first trip over the line in 1883, he is quoted as having said to his associates that they had either built this line 300 miles too long, or 300 years too soon.[5] Yerington and Sharon were the active promoters of the line; Mills had apparently accepted their plans without too much attention to details.

During the 20-year life of the Carson and Colorado as an independent road,

FIG. 5 (left). Potash and soda plant at Keeler, operating since the Carson and Colorado was completed in 1883.

FIG. 6 (right). One of the original passenger cars of the Carson and Colorado, still in service (as a caboose) on the Southern Pacific in the Owens Valley. Picture taken at Keeler; Inyo Mountains in background.

only one extension was ever built, a seven-mile branch southward into the Cottonwood district, constructed in 1891. This branch was dismantled in 1902. A potential feeder line, which operated a section of track, but never reached the Carson and Colorado, was the Bodie Railway and Lumber Company, later known as the Bodie and Benton Railway, which was constructed from Bodie southward to tap timber resources on the hills south of Mono Lake, for use in the Bodie mines. Thirty-one miles between Bodie and Mono Mills were built, at a reported cost of $450,000, and placed in operation in November of 1881. In the first ten miles out of Bodie, the line dropped 1900 feet, on grades as high as 6 per cent. The project was financed primarily by Yerington and A. J. Ralston, who had considerable interest in the lumber mills. Apparently they planned to extend the line to connect with the Carson and Colorado near Benton if sufficient prospective business developed. However, the steep grades and roundabout route offered relatively little advantage over the direct wagon route to Hawthorne. In any event, the decline of Bodie after 1885 precluded the building of the extension. In the late nineties the line was dismantled. During its entire life it was never closer than 25 miles to any other railroad; its locomotives, cars, and rails were hauled overland from Hawthorne by mule team. Its traffic was almost entirely lumber; freight to and from Bodie continued to move via the wagon route to Hawthorne.

THE COMPLETED LINE

The completed Carson and Colorado in 1883 extended 294 miles from Mound House to Keeler, with an additional five miles of line on the Candelaria branch (Fig. 2). Construction costs had been kept as low as possible; three foot gauge, which was expected to allow savings of $250,000, was selected for this reason.[6] As a result, transfer of all interline freight at Mound House was necessary. Tunnels were avoided, except for the one in Montgomery Pass, and bridges were held to a minimum; as a result, curvature between Mound House and Churchill, and in Montgomery Pass, was very great. The only significant grade was in Montgomery Pass, with a maximum of 3.2 per cent. The latter raised operating costs considerably; one locomotive was required for every six loaded freight cars on northbound trains through the pass.

Exact figures on construction costs are not available. Estimates range from $4,500,000 to $6,000,000, or from $15,000 to $20,000 a mile, including expenditures for equipment. In United States Interstate Commerce Commission, Statistics of Railways, 1899, page 688, the cost of the road is shown to be $6,380,000. But the fact that this figure is exactly equal to the road's capitalization following the 1892 reorganization suggests that it is not an accurate cost figure. In contrast to the financing of the Virginia and Truckee, no government aid was obtained, except for some grants of right of way. In exchange for the right to cross the Indian Reservation at Schurz, the company agreed to carry all Indians of the reservation and goods shipped by them free of charge.

Capital was supplied largely, if not entirely, by the Mills-Sharon group. The total par value of stock issued by the three original Carson and Colorado corporations was $4,380,000; total bonded debt of the three companies was also $4,380,000. The entire amounts of the stock and bond issues were given to the construction company in compensation for the building of the line,

and passed from the latter into the hands of those promoting the enterprise. From all indications the latter retained ownership of both bonds and stock. The total par value of the stock and bonds was clearly in excess of the cost of construction.

By 1883 the company had acquired eight locomotives, all wood-burning Baldwin 4–4–0's.[7] With the exception of Number 2, the Colorado, they were named for the towns in the area: Candelaria, Bodie, Churchill, Belleville, Hawthorne, Benton, and Darwin. These were the only locomotives the company ever owned. By 1885 the line had six wooden coaches, and about 180 freight cars, half of which were open platform cars, used for hauling ore and mine timbers.

PROFITABILITY

The first two years of operation resulted in profit figures which, had they continued, would have justified the investment. In 1882, with only 199 miles in operation at the end of the year, gross revenue totalled $442,254, net operating revenue $246,103, and net profit $111,103. But the profits quickly came to an end. Both Bodie and Candelaria had actually reached the peak of their production by the time the line was completed. The former declined rapidly after 1883; the population was only 595 by 1890. Candelaria's original bonanza mine, the Northern Belle, ceased operations following litigation in 1884. The Mount Diablo and Argentum mines continued heavy production for a short time, but by 1891 ore deposits had been exhausted. The total yield of the mines in the Candelaria area declined from $1,205,457 in 1883 to $497,958 in 1885, and $259,446 in 1890. After 1891 output was almost nil. By 1890 population had fallen to 345; by 1900 it had reached 160. Farther south, Darwin likewise was on the decline. Cerro Gordo, although destined to continue production down to the present time, had also passed its peak. In 1883, with 100 miles of additional line in operation, the road's gross revenue fell to $441,994, and net operating income to $196,307. No earnings figures are available for the years between 1883 and 1888; in the latter year, gross revenue had fallen to $298,280; net operating income was $130,493, and net deficit $162,766.[8] By 1891, accumulated unpaid interest totalled $850,333. During the decade of the nineties, revenue fell almost continuously; a low of $131,096 gross revenue was reached in 1897; this was less than one-third the 1883 figure.

In 1892 the road passed through reorganization. The capital stock was left intact; the debt was reduced to $2,000,000, and the interest rate to 4 per cent. The three corporations were consolidated into one, designated as the Carson and Colorado Railway Company. The reorganization was largely a formality, since from every indication the Mills group owned both bonds and stock. In any event, the group retained full control after the reorganization. Despite the reduction of interest charges from $262,800 to $80,000 annually, the road did not earn the charges in any year prior to 1900. The Company avoided operating losses, however; in large part this was due to rigid economies. For example, general administrative expenses were only $2,153 in 1890.

The earnings picture was a reflection of the low levels to which Nevada mining fell during the later eighties and nineties. Two factors were responsible; namely, the decline in silver prices, and the failure to discover new ore bodies. The five counties of the area, which contained 17,931 inhabitants in 1880, declined

in population to 11,924 in 1900, despite a 1449 increase in Inyo County, and increases in the farm areas of the Mason Valley.

ECONOMIC SIGNIFICANCE OF THE LINE

The building of the line brought substantial reductions in freight costs for the area. The average freight revenue per ton mile of the company ranged during the period from 4¢ to 6½¢, in contrast to the 25¢ to 30¢ figures of the freighters. One of the road's first tariffs quoted rates of $12 a ton on grain from Mound House to Hawthorne (100 miles) and $6 a ton on borax between the same points. In comparison, the rate on freight by wagon from Hawthorne to Bodie (40 miles) was $20 a ton. The rate on ore from the Santa Fe district near Hawthorne to the Dayton mills was $5 a ton, compared to a previous $60 a ton cost by wagon.

The railroad was designed primarily to serve the mining interests; the latter provided the majority of the freight carried. In 1890, for example, 50 per cent of the road's tonnage was ore, and 18 per cent was lumber, used primarily by the mines.[9] Yet apparently mining benefitted relatively little from the road, despite the substantial rate reductions. As indicated above, during the last two decades of the nineteenth century, mining declined continuously throughout the area. While the railroad may have slowed down the rate of decline, its own tonnage figures, which in 1897 were only about 22 per cent of the 1883 figures, show that the effect could not have been very significant. One reason was the failure of the track to reach the mines directly, except in Candelaria. The construction of the Virginia and Truckee had made possible the movement of large quantities of low grade ore which would not stand the cost of freighting. But virtually every mine in Virginia City had its own siding, on which its supplies came in and its ore went out. But the Carson and Colorado was unable to reach the mines themselves; the necessity of a wagon haul and rehandling checked the movement of any substantial quantities of low grade ore.

The line was of greater importance in facilitating the development of nonmetallic natural resources. Plants were established on Owens Lake for the production of potash and soda; these undertakings, which would have been impossible without the railroad, supplied it with considerable traffic (Fig. 5). An attempt was made by the Nevada Salt and Borax Company to work the Columbus marsh deposits; between 1884 and 1888 total output was reported to be $87,197. This project was abandoned. Operations on Teels Marsh by the Teels Marsh Company were considerably more successful; between 1884 and 1893 total yield was $649,308. Another undertaking was the development of the quarrying of marble in the hills on the east side of Owens Valley near Keeler.

Agriculture, in which the builders of the road showed little interest, actually was affected more by the construction of the road than was mining. Owens Valley was materially aided.[10] The valley supplied large quantities of hay for the horses and mules of the mining communities, first Candelaria, and later Tonopah, Goldfield, and adjacent areas. In 1890, for example, the tonnage of hay carried by the line exceeded that of any other farm product. In addition to hay, the Owens Valley supplied most of the meat and a portion of the vegetable supplies to the mining towns. As a result, the Owens Valley area became economically tributary to Nevada rather

than to southern California, from which it was separated by a hundred miles of desert trails. The Mason Valley, although touched by the railroad only at one corner, grew steadily between 1880 and 1900. The town of Mason Valley, renamed Yerington in honor of the line's president, attained a population of 577 in 1890, and 709 in 1900. The large cattle ranches of the 1860's gave way to smaller farms, irrigated with Walker River water. Produce moved south, to Hawthorne, and later Tonopah and Goldfield, and northward to Virginia City. Wabuska remained the shipping point for the valley products; not until 1911 was a rail line (the Nevada Copper Belt) built through the valley to Yerington, Hudson, and Ludwig.

Throughout the area, the standard of living of the settlers was improved by the lower transportation costs on manufactured goods and other supplies obtained from California and the East. For example, freighting costs to Independence from San Francisco on merchandise were $5.96 per 100 pounds. The rail rates did not exceed $2.00 per 100 pounds.

The only important settlement for which the railroad was responsible was Hawthorne, which had attained a population of 436 by 1900. The growth of Hawthorne was slow, however, compared to the expectations of the promoters of the town. The belief of the latter that the Belleville mills would be moved to Hawthorne because of better timber resources was never realized, in part because of the decline of the Candelaria mines after 1883. Other stations established, such as Churchill, Wabuska, Luning, Basalt, Benton Station, Laws, Zurich, and Aberdeen, consisted of little more than station buildings and houses for section workers. The agricultural settlements of the Owens and Mason Valleys continued to grow during the period; all of these were older than the railroad, however, and remained in their original locations, even though the railroad missed them by several miles.

The passenger service of the road provided definite improvements over stagecoach travel; for example, travel time from Carson City to Candelaria was reduced in half, from 24 hours to 12. But travel on the line was not exactly pleasant; the light roadbed, the sparks of the wood-burning locomotives, the desert sands (especially around Luning), and the slow speed did not allow a very comfortable ride. From 1881 to 1901 the road operated its trains in mixed freight and passenger service. Two days were required to make the run from Mound House to Keeler. The trains originally ran to Candelaria the first day, but as the latter declined the overnight stop was moved to Hawthorne. Later the stop was moved to Sodaville, to facilitate stagecoach connections to central Nevada points. Passenger fares were high by present-day standards; they averaged 7.3¢ per mile in 1890, and 5.4¢ in 1899, for example. These figures were not out of line, however, with fares at the time on other light traffic lines, and were cheaper than the typical stagecoach fares. Passenger traffic was never heavy; in later years trains handled only one coach. In 1894, for example, an average of 24 passengers a day was carried, for an average fare of $4. Despite the light traffic, passengers accounted for roughly 25 per cent of the road's revenue during the period.

SALE OF THE ROAD TO THE SOUTHERN PACIFIC

By 1900 the Carson and Colorado appeared hopeless from a profit stand-

point. For 15 years the road had earned only a small fraction of its interest charges, and no return for the stockholders. After the reorganization in 1892, the road ceased to set up a charge in its accounts for interest. The bondholders (who were also the stockholders) were simply paid the sums available each year after other charges were covered. Maintenance had been held to a minimum; for example in 1899, maintenance of way expenditures totalled $87 a mile. As a result, both track and equipment had deteriorated. Furthermore, after 1892, the revenues of the parent Virginia and Truckee Railroad fell rapidly, as the Virginia City mines exhausted the low grade ore which had prolonged their life after the bonanza ores had been worked out. Net income of the Virginia and Truckee, which had been $208,500 in 1892, and which had never been below $200,000 annually during the life of the road, fell to $28,567 in 1894.

Accordingly, when the Southern Pacific offered to buy the entire line of the Carson and Colorado in 1900, the owners were very sympathetic to the proposal. The Southern Pacific, still under California control and management, was interested in the line as a portion of a contemplated short cut between the Los Angeles area and the San Francisco–Ogden route. At this time there was no direct rail route between Salt Lake and Los Angeles; traffic between the intermountain area and southern California was routed via Sacramento. The Mills-Sharon group accepted an offer of $2,750,000 for the outstanding stock and bonds of the line Control was transferred March 1, 1900; Henry Huntington, nephew of one of the founders of the Central Pacific and Southern Pacific, replaced Yerington as president of the road. The line, however, was operated as a separate entity, and temporarily under its old name. The Southern Pacific also offered to buy the Virginia and Truckee, but the parties could not agree upon a price; as a result, the Carson and Colorado remained physically disconnected from the lines of its new owner. The latter planned, however, to build connections at both ends.

Shortly after the purchase of the Carson and Colorado, control of the Southern Pacific passed into the hands of the Harriman interests. The latter abandoned the plans for the use of the Carson and Colorado as a through route, probably because of the proposed extension of the Union Pacific to Los Angeles. The latter project was completed in 1905.

From the standpoint of Mills, Sharon, and Yerington, the sale of the Carson and Colorado for $2,750,000 appeared to be a good bargain. Although the original cost was considerably greater, on the basis of capitalization of earnings in the five-year period prior to 1900, the sale value would not have exceeded $300,000. Actually a reasonable sale figure would have been less, in view of the deteriorated condition of the line, and the poor prospects for the future. But events within the year were to prove the sale to be a colossal mistake. On May 18, 1900, a prospector named Butler, on his way from his ranch in the Monitor Valley to a small mining camp known as Southern Klondike, camped overnight on a ridge of the San Antonio Mountains, 70 miles east of Sodaville. While hunting his missing burro the following morning he discovered a ledge of ore which was to prove to be the biggest bonanza since Virginia City. During the next two years Tonopah—as the new camp was called—rivalled the Comstock in its best years. Then in 1904 came the equally rich discoveries at Goldfield, 30

miles south of Tonopah. Almost overnight the Carson and Colorado began to prosper. Gross revenue, $146,238 in 1899, reached $180,097 in 1901, $466,205 in 1903, and $1,960,185 in 1907. The latter figure exceeded the total gross revenue for the entire ten-year period between 1890 and 1900. In 1907, the peak year, income after interest and taxes exceeded $1,000,000.

The great increase in traffic, in the face of limited equipment and the need for rehandling all freight at Mound House, led to a severe traffic tie-up; shipments were delayed for weeks at the transfer point. The need for standard gauging became apparent very quickly; this change was completed as far as Tonopah Junction, near Sodaville, in 1905. At this junction point the newly-constructed Tonopah and Goldfield Railroad connected the line with the new mining areas. For operating purposes the southern terminal of the standard-gauge segment was placed at Mina, nine miles north of Tonopah Junction. Tonopah and Goldfield trains operated into Mina from the junction by authority of trackage rights. The section between Mina and the Junction was laid with three rails, so that the narrow gauge trains from the Owens Valley could reach the Mina terminal.

At the time of the change in gauge, a new line was built from Churchill directly north 28 miles to Hazen, on the Southern Pacific's main Reno-Ogden line. As a result the haul over the Virginia and Truckee between Mound House and Reno was eliminated. The effect upon the Virginia and Truckee was disastrous; its gross revenue, almost as great in 1905 as in the eighties, was cut by half, and its net income by more than two-thirds. Its owners, however, without question, expected the Hazen line to be built when they sold the Carson and Colorado; what they did not anticipate was the great increase in traffic on the latter. The line between Churchill and Mound House remained in operation until 1934, but little traffic passed over it. Another physical change made in 1905 was the straightening of the line in the vicinity of Hawthorne, in order to eliminate the drop to the floor of the valley, and to shorten the length of the main line by several miles. As a result, Hawthorne, the only town for whose establishment the road was directly responsible, was left six miles away from it.

Likewise in 1905 a change was made in the corporate structure, which eliminated the Carson and Colorado Railway Company. A new corporation, known as the Nevada and California Railroad Company, was chartered; to it was transferred all property of the Carson and Colorado, and the new Churchill-Hazen line mentioned above was built by it. In addition the Southern Pacific transferred to it the newly constructed line between Hazen and Fallon. The Nevada and California was wholly owned by the Southern Pacific; it was operated as a separate entity until 1909, and under a lease arrangement, but with separate operating accounts, from 1909 to 1911. In 1912 the physical property of the road was transferred to the Central Pacific, and the Nevada and California ceased to exist. Since that time the property has been operated as an integral part of the Southern Pacific system.

Between 1908 and 1911 the southern extension, planned for 30 years, was completed, primarily for the purpose of handling materials for the Los Angeles aqueduct, which was being built to carry Owens Valley water to the Los Angeles area. The extension consisted of a standard gauge line between Owenyo, 17 miles north of Keeler, and Mojave, 144 miles to the south. At

last a continuous line of railroad extended directly from Los Angeles and Mojave to Reno. But the 151-mile section between Owenyo and Tonopah Junction was narrow gauge, and no through cars could be handled. Actually the narrow-gauge portion merely served as a feeder for the two standard-gauge portions. The Southern Pacific management never revived the old plan of developing the line as a through route by standard gauging the remainder. The building of the Salt Lake–Los Angeles line of the Union Pacific had of course lessened the need for the use of the Carson and Colorado route as a short cut to Southern California. In 1937 the line over Montgomery Pass, between Tonopah Junction and Benton Station, was abandoned, and the through line broken. The Candelaria branch, long unused, was removed in 1931. Candelaria, the original destination of the line, is completely deserted; the mine dumps and wreckage of a few stone buildings mark the site. The location of Belleville is indicated only by the dumps from the mills. Additional mileage between Benton Station and Laws was removed in 1942. Thus there remains today only 70 miles of narrow-gauge track, from Laws to Keeler, operated on an irregular basis for the handling of carload shipments, primarily of ore and livestock, which are transferred to standard-gauge cars at Owenyo. Some of the rolling stock on the line is original Carson and Colorado equipment; the three locomotives, however, are ex-Nevada-California-Oregon Railway motive power. Agricultural production in the Owens Valley was reduced materially after 1910 as a result of the diversion of water to Los Angeles.

The standard gauge northern portion of the line now ends at Mina, since the abandonment of the Tonopah and Goldfield Railroad in 1947. A substantial volume of freight—primarily ores, and shipments for the Naval Ammunition Supply Base at Hawthorne—moves over the line. The Nevada Copper Belt Railroad was likewise abandoned in 1947. The pioneer Virginia and Truckee, though now separated from the line which was the Carson and Colorado, and with its old main line to Virginia City abandoned in 1938 following the collapse of a tunnel, continued to operate between Reno, Carson City, and Minden until 1950, when inadequate business forced its abandonment.

CONCLUSION

The story of the Carson and Colorado bears considerable resemblance to those of other railroads built to serve mining areas. Many of these roads were constructed as the mining booms were nearing their peaks; profits of the first few years gave way to long periods of losses, and eventual abandonment, unless other economic developments provided new traffic. Railroad promoters in the mining areas caught the fever of unbounded enthusiasm which prevailed during the bonanza periods; provided that they could obtain the necessary funds, they undertook projects which had only limited potentialities on any realistic basis.

But few projects rivalled the Carson and Colorado in magnitude, and in the speed with which it was carried to completion. The latter was made possible by the fortunes of Mills, Sharon, and Yerington, and their willingness to invest large sums in the venture. The interest of these men in mining led them to undertake the project when other projects on the West Coast would apparently have offered better profit prospects on the basis of rational calculation. Few other similar under-

takings netted so little to the promoters in the way of returns; the irony in the story was of course the sale of the road only months before it began to reap the fruits of a new mining boom far greater than the one which led to its construction. Although the Carson and Colorado aided the development of the resources of the area served, the potentialities of the region were so limited that the results were not substantial. A line of comparable mileage in other regions on the Pacific Coast would have produced far more significant results in the development of the utilization of resources.

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THE ECONOMIC GEOGRAPHY OF ATOMIC ENERGY

A Review Article

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THE publications upon which this article is based are only a sample of the literature on the industrial uses of atomic energy.* This literature has arisen largely in advance of the fact and rests on rather shaky foundations. What it will cost to produce atomic energy for industry is at best an informed guess, and the average of nine, or ninety, guesses is still a guess. Nevertheless these publications cannot be brushed off as idle speculation. They contain solid ideas for outlining the possibilities.

Even to speculate about the economic possibilities of atomic energy may seem pointless in this time of international tension. But paradoxically the war emergency, with its great demands for power, may speed the industrial use of atomic energy, especially if it proves possible for the same reactor to serve both military and industrial purposes. However and whenever they may come about, it is the possible changes in the location of industry that may result that most interest the economic geographer.

Some Technological Problems

Before there can be any atomic power at all, some technological problems must be solved. Before atomic power can be widely used, the solutions of these problems must, as Etherington says, be transferred from the realm of physics to that of engineering. A nuclear reactor for industrial purposes must operate at much higher temperatures than those built during World War II. Temperatures at least as high as those now employed in conventional steam plants must be attained—perhaps 1050°, Fahrenheit. Actually, atomic energy may make possible much higher temperatures. No oxygen is involved in atomic fission, so that gases heated by nuclear energy will be less corrosive than those produced by combustion, if used in a gas turbine. Within the reactor itself, however, deterioration of materials may be an important item of expense. Repairs and replacements within the reactor will have to be made by remote control.

Natural uranium does not contain enough of the fissionable U-235 to make feasible the economical operation of a reactor at industrial temperatures. A fissionable concentrate must be added. This concentrate may cost a thousand times as much as natural uranium. (Even so, it is comparable in terms of energy to medium-priced coal.) Once the reaction is established, fissionable materials will breed within the reactor, perhaps in quantities more than sufficient to sustain the desired temperature. Successful "net gain breeding" of fissionable materials in industrial reactors, as ordinary uranium and thorium are

*All books and articles referred to are listed in the bibliography.

consumed, will mean that (in the cautious words of Dunning) "an appreciable fraction" of the uranium and thorium of the earth may be utilized for atomic fuel.

One of the question marks of atomic technology, as far as public information goes at the time of writing, is the extent to which a nuclear reactor can serve multiple purposes. Schurr and Marschak wonder whether the high temperatures desired for industrial purposes will prove the best for net gain breeding. Cockroft says that breeder piles "present difficult technical problems and may take a considerable time to develop into reliable power units." The solution of these problems will be an important milestone, for if an efficient industrial reactor can produce a surplus of fissionable materials, a profitable tie between military and non-military use may result. On the other hand, if industrial reactors require replenishment with fissionable concentrates they will be in competition with military needs. In an article in *Time*, C. A. Thomas, of the Monsanto Chemical Company, is stated to believe it possible to generate heat for industrial use and at the same time realize a revenue from the sale of plutonium bred within the reactor. Since Thomas has been on the conservative side in his estimates of the cost of atomic energy, this statement is significant.

The removal of fission products from the nuclear fuel is a delicate mechanical and chemical operation. Dunning suggests the possibility of using the fuel in a fluid suspension, permitting circulation and processing. The disposal of dangerous radioactive wastes he regards as a problem that may be solved "with full safety and without excessive costs," since the quantity might be only a pound or so a day even from a very large power station.

The technological problems of developing atomic energy will limit the first installations to the industrially advanced nations. As long as international relations remain tense, the specialized apparatus and "know-how" are not likely to be freely exported, especially if the breeding process makes every industrial reactor a source of extra plutonium. If this means that each nation must develop its own atomic technology or do without, many small or backward nations must do without. "Unto him that hath shall be given"—a common principle in economic geography—may thus operate in the atomic field.

FUEL SUPPLY AND COSTS

It is now well known that uranium and thorium are relatively abundant and widespread. Moreover, even at a hundred times its present price, uranium would be very cheap in terms of energy. This is a far cry from saying that granite will become an ore of uranium, but it does indicate that atomic fuels for industry can be drawn from other sources than the few high-grade deposits now known. Net gain breeding of the much more valuable fissionable products might even turn the fuel cost into a profit.

Schurr and Marschak describe uranium as "an amazing fuel, which could absorb enormous increases in the cost of prying it from the earth and refining it and still remain cheaper than the cheapest coal." This low, perhaps negligible, and possibly negative fuel cost (depending upon the success of net gain breeding) should not be given undue prominence. One well-known source of power has no fuel cost. This is hydroelectricity. The unique property of atomic fuels is their great transportability. This is the line on which the ultra-enthusiastic believers in atomic energy make their last stand. Pushed to admit that atomic energy will be

far from free and, even if free, would not greatly reduce the production costs of many industries, they point out that the fuel for a nuclear reactor could be flown to the South Pole if need be. The rejoinder is a question: Does it need to be?

Even though uranium and thorium are relatively widespread, the geography of their ores is by no means unimportant. It would depart from all previous experience with the minor metals if their occurrence showed a nice congruence with the industrial or military requirements of nations. Possession of, or reliable access to, the more easily mined deposits will certainly be highly desired. The great powers will probably seek to control the international movement of these ores. Possession of an important deposit will give a small country a valuable diplomatic lever. The "economic geography" of atomic energy may thus reflect political geography as much as it does strictly economic forces.

COSTS OF ATOMIC POWER PLANTS

No way is now foreseen to use directly the energy of atomic fission. All the proposed methods involve the transfer of the resulting heat by liquids, molten metals, or gases. Because of radiation hazards, the schemes diagrammed by Dunning employ a second heat transfer (in spite of the inevitable loss) between the reactor and the driven machinery. The nuclear reactor is therefore really a new type of fire-box rather than a complete power plant.

Estimates of the cost of atomic energy have been made on the assumption that the heat will be converted into electricity by conventional means. This may not be true for all purposes. Hot gases may be used directly in kilns or furnaces. Following the customary analysis, however, we note that much of the apparatus for generating electricity will be identical with that of a conventional steam plant. Therefore, there is little reason to expect that atomic power plants will be cheaper than conventional ones. At least in the early years of their development, they are likely to cost more. Control systems will be elaborate, with remote-control apparatus for repairs, and facilities for removing the radioactive "ash" from the fuel will be needed. This last may be very expensive, but it has been suggested that a central processing plant might serve a number of power stations. The lowest estimates of cost for atomic and conventional plants of equal capacity are about the same. On the high side, Sporn cites estimates for atomic plants that run to seven times the cost of conventional plants of the same size. The unreliability of all the estimates is stressed by Isard and Whitney and is crisply stated by Hafstad who says that accurate cost figures ". . . do not exist even within the Atomic Energy Commission. If they did exist, they could not be released for security reasons. If they did exist and if they could be released, I wouldn't believe them anyway."

By postulating large economies with increasing size, it is possible to imagine an atomic power plant that is cheaper per kilowatt of capacity than a conventional steam plant. But if we think in terms of "atomic Niagaras" we greatly limit the possible applications. There must be a large market, in existence or highly probable, within transmission range. Only well-heeled governments or very large corporations could pay the initial costs.

Schurr and Marschak, while fully realizing the difficulties, make estimates (in 1946 prices) of the cost of electricity generated from atomic energy in a 75,000 kilowatt plant at 50 per cent of capacity. They class their results as

minimum (4.0–4.3 mills per KWH), intermediate (6.6–7.0 mills) and maximum (10.2 mills). Two things are noteworthy about their estimates. One is that 80 per cent of the cost of atomic electricity is charged to fixed costs. Others agree that capital investment may play a very important part in the cost structure. Isard and Whitney estimate that a 3 per cent increase in interest rates means a 2.5 mill increase in cost per kilowatt-hour. (They point out, also, that interest rates are lowest in the most advanced countries.) Secondly, the cost estimates of Schurr and Marschak are of the same general order of magnitude as the cost of electricity generated in conventional thermal plants and are considerably higher than low-cost hydroelectricity. This point is well brought out by an interesting world map of electricity generating costs. Current (no pun intended) thought, then, is that atomic energy may be competitive with coal. This is a far cry from "a world set free" by unlimited, virtually cost-free energy. It makes atomic energy not really revolutionary (in an economic sense) but rather one more possible source of power that an engineer must consider in a given case. Whether he chooses it or a conventional fuel for a given location and purpose will not be answerable with confidence until practical experience with nuclear power plants has been gained.

ATOMIC POWER IN SELECTED INDUSTRIES

Among the most interesting parts, to a geographer, of the Schurr and Marschak book are the discussions of the possibility of using atomic power in specific industries. Isard and Whitney give a briefer treatment of the same theme. Both publications make it clear that the impact of even free energy upon the location of industry would be far from uniform. Energy costs range from an almost negligible fraction of total costs in some industries to as much as one-fifth in a power-hungry process like aluminum refining. (A proposed electrical process for manufacturing phosphate fertilizer would spend one-third of its total costs on energy.) Since atomic energy actually will be little, if any, cheaper than energy from conventional sources, the savings (again, if any) would be only a fraction of a fraction, though even a tiny saving per kilowatt-hour can be important in an industry with heavy power demands.

There are, however, two other routes to possible savings through the use of atomic energy. One results from the easy transportability of atomic fuels. This makes possible the relocation of some industrial processes so as to effect savings in the transportation of raw materials or finished products, even though there is little or no economy in energy costs. One such possibility is the refining of aluminum at the mine instead of shipping the bulky ore. The second possible route to savings is to introduce new processes, perhaps combined with locational changes that would reduce transportation costs. Schurr and Marschak suggest that the sponge-iron process, using hydrogen as the reducing agent and atomic energy for the production of the hydrogen and the required heat, might permit the smelting of iron at the mine, thus eliminating the shipment of both ore and coal. (Their computations, however, lead them to conclude that the economic feasibility of such a step is highly speculative.) The most fruitful applications of atomic energy, if it is possible to use it in economic rather than politically-determined ways, may lie along such lines. As Schurr and Marschak say, "If really revolutionary results occur they will probably come about through the in-

vention of entirely new applications of atomic energy rather than simply through lessening the cost of electricity."

REGIONAL REDISTRIBUTION OF INDUSTRY

Part Three of Schurr and Marschak's book, dealing with *Atomic Power and Economic Development*, and pages 46–50 of Isard and Whitney's paper would be well worth reading by geographers (who shy away from the more theoretical work of economists) even if they had no interest in atomic energy. Without jargon or the use of symbols, these readings show the economist at work with his sharp tool, the study of costs. That the cost of atomic energy is not accurately known does not vitiate the arguments. It merely makes the results algebraic, so to speak, rather than arithmetical. But both these readings end with a deferential bow to political factors, which may localize the supplies of atomic energy without reference to costs.

To follow out first the arguments based on cost: Isard and Whitney point out that the use of atomic energy may tend to reinforce existing patterns of industry rather than to alter them. The economies of large plants will favor their construction near large markets. On the other hand, a number of the underdeveloped areas have unused energy sources at hand. "In Rhodesia, for example, where there are excellent coal deposits and where excellent hydro sources are within reach, economic backwardness is not due to lack of power resources. In the case of such countries it seems foolish to think that the introduction of a new power source will bring about any transformation."

Isard and Whitney argue further that cheap atomic energy might favor the concentration rather than the dispersal of industry, though perhaps a concentration at new sites. Those industries, like aluminum refining, that are attracted to power are also strongly affected by small differentials in the cost of power. Electricity generated by atomic energy will not be of the same cost everywhere. It will be cheapest near very large installations, in countries of advanced technology and low interest rates. Cheap atomic electricity might draw aluminum refining, for example, to the mine or to the market, but in either case there might be concentration about a few large power plants rather than dispersion about many small ones.

Schurr and Marschak are more hopeful about the role of atomic energy in the industrialization of underdeveloped lands, although they point out the need for capital (roughly $1000 for each new worker), skills, and raw materials as well as power. They estimate that four to eight tons of coal, or its equivalent in other forms of energy, are needed for each new worker employed in industry. This energy is available in conventional forms in some underdeveloped areas and can be transported to most of them. But investments in railroads, rolling stock, and mines, in the case of coal, and in dams and transmission lines, in the case of water-power, may add very substantially to the costs. In terms of total investment, atomic power might prove cheaper in some cases.

Schurr and Marschak also discuss the underdeveloped countries "which propose to industrialize by plan—and many backward countries do." Planning may lead to the location of industries for social, political, or military reasons, without strict regard to costs. In such conditions, the use of atomic energy may be indicated if there are no local supplies of energy in conventional forms and if imported supplies are expensive. Schurr and Marschak conclude: "There

are not many areas of the world that meet all these criteria, but among them are several of real importance: Pakistan, central and southern India, and the east coast of South America, particularly Argentina." Important though they be, they are a rather small residue from the underdeveloped world. One can only guess whether these lands can bargain or make their own ways into the coterie of nations having atomic energy. One can only guess whether these lands can bargain or make their own ways into the coterie of nations having atomic energy. Newspaper reports state that India is constructing an experimental reactor while from Argentina have come spectacular but doubtful claims of a simple way to produce the hydrogen-helium transmutation.

POLITICAL FACTORS

We have already seen repeatedly that political considerations may play an important and perhaps determining role in deciding if, how, when, and where atomic energy is used for industrial purposes. The importance of atomic energy in world politics was so clear that the strongly capitalistic Congress of the United States placed the whole atomic development program under a government commission with little hesitation. There is no likelihood of the program as a whole being de-nationalized. Use of fissionable materials for energy development by private enterprise is not only possible but likely, but certainly it will be under the license and ultimate control of the Atomic Energy Commission. Not even in a World State does it seem likely that atomic energy could be turned over completely to private hands, for a World State would have to be on guard against rebellions, and a rebellious province with atomic bombs would be formidable indeed.

Government participation introduces an element of unpredictability into almost every phase of atomic power development. Government determines how much effort is put into the necessary research. Government determines how much fissionable material will be released to industry. Costs may be lowered by government subsidies or through government purchases of the products of net gain breeding. The location of reactors may be determined by the convenience of government rather than that of industry. The need to counter communism might push government towards the export of atomic materials and equipment, but the fear of giving atomic explosives to possible enemies will work in the opposite direction—and more strongly, in the reviewer's opinion. All in all, it looks unlikely that those who read these lines will ever see a geography of atomic energy that is truly an economic geography.

SOLAR ENERGY

By stretching the common usage of the term, solar heat may be called a form of atomic energy. Efforts to use solar heat are much older than even the knowledge that atoms contained energy, but they appear to be farther from practical success than are methods of using nuclear reactors. The direct use of solar heat for generating steam appears to be uneconomic. An acre of mirrors provides little more power than a large outboard motor. Use of solar heat for house heating may be practical, but this review focusses (again, no pun intended) on industrial applications. The amount of solar energy falling on the United States exceeds the country's

energy requirements two thousandfold but how to harness this energy for industry is an unsolved problem.

Thermoelectricity, thermochemistry, or photochemistry may be the fields in which to find the philosopher's stone that will transmute sunshine into industrial energy. Currently, much thought is being given to photosynthesis. Even if this cannot be used directly to produce usable energy, it may be possible to grow vegetable fuels or vegetable sources of inflammable liquids. Under controlled conditions, as in a greenhouse, it is possible greatly to improve on nature's records. A theoretical yield of 200 tons per acre per year is possible, as against a few tons for even the most prolific field crop. But out of doors, taking the sun and the rain and the carbon dioxide as they come, nature is a closer competitor to science. Food yields can be increased substantially and profitably, but the chances of raising fuel in fields, at going prices, are slim. Daniels concludes his survey hopefully but soberly, "Practical atomic and solar energy will come slowly, but both have considerable promise."

The economic geography of solar energy—presumably would show some relation to the map of solar radiation received at the earth's surface. But energy is only one factor in industry, and often only a minor factor. There would be no reason to speculate in industrial sites in Saharan oases. For one thing, water is a requirement of most industries and is less mobile than is energy. We might expect, however, the successful harnessing of solar energy to reinforce the southward spread of industry that has been going on in this country and to assist the industrialization of the Mediterranean lands.

The industrial use of solar energy might differ in one important respect from the industrial use of atomic energy. If, as seems reasonable, solar energy has no special military value, there would be no political obstacles to the spread of its use. If the technology is not excessively complex and if the installations need not be of great size, it may be of greater significance to underdeveloped tropical and subtropical countries than atomic energy. There is surely reason to hope that, if solar energy can be harnessed economically at all, the means may be little or no trickier than those needed for conventional sources of power.

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BOOK REVIEWS

The Rural Economy of New England, by JOHN D. BLACK. xxiv and 796 pp.; maps, diagrs., charts, tables, index. Harvard University Press, Cambridge, 1950. $7.50. 9½ x 6 inches.

From the first sentence of its opening chapter to the last sentence of its concluding chapter, *The Rural Economy of New England* moves logically and smoothly, almost relentlessly, through the maze of facts about a way of life in a small portion of the United States, and through the implications of the changes which have occurred in the past quarter century, to a statement of future prospects. In the preface, the author, John D. Black who is Henry Lee Professor of Economics in Harvard University, describes the book as an end product of group research begun in 1929 and virtually finished in 1941. War interrupted original plans. Further research, in the form of analysis of the 1945 census data, brought the study period through a full two decades. The completed work is a synthesis by the author of the intensive study of many individuals. The study was financed by the Committee on Research in the Social Sciences and by the Graduate School of Public Administration, both of Harvard University.

The Rural Economy of New England begins with a chapter entitled "The Assignment" in which the objective of the whole work is clearly and succinctly set forth. "The task the author has set for himself . . . is to take a small section of the United States . . . and to analyze its rural economy in a way that will serve as a guide to its future." Mr. Black goes on to state that this is a kind of regional study, but not the usual kind. He points out that it does not attempt to analyze all phases of civilization in New England, but rather that it concerns itself with one phase of the region's economic life, drawing upon other phases only as necessary to illuminate rural land use and rural living. The study is approached from the country toward the city and not from the city as a focus of activity outward to the farm. And, finally, no master plan is offered as a conclusion.

Chapter 2 "What is New England?" follows the statement of objective. Here, the geographer's interest is immediately captured, for the chapter is a discussion of the author's attitude toward regions and regionalism. It is always difficult, and it may unconsciously be unjust to the author, to extract a single sentence from its context and yet retain the proper meaning. To this reviewer, however, the author's attitude is most accurately expressed when he writes, "The most useful basis of classification of areas for this and other studies like it is *similarity of interests and of social relationships.*" Whether or not one agrees completely is not significant to this review; the fact that the author recognizes the difficulties and states his solution of those difficulties is enough. Mr. Black has done this clearly and he is to be praised for it.

After the definition of objective and of the area for which the objective is posed, there is a detailed presentation of the physical and cultural facts to be analyzed. This leads easily into the general statement of the economics of agriculture for New England as a whole. Included are such topics as "Organization of Agriculture," "Evolution of Agriculture," "Marketing of Farm Products," and "Prices of Farm Products." Somewhat more than one-third of the whole volume is thus concerned primarily with the presentation of the over-all view, a sort of scene-setting before the play begins.

There follow eleven chapters on specific types of rural activity, such as dairying, poultry farming, specialty crop farming, woodland management, and recreational land use. In each of these chapters, the depth of the study becomes thoroughly evident. Two further chapters summarize this portion of the work with analyses of income from land use and farm family living.

A return to emphasis upon the region follows in the discussion of land values, credit and tenure in land use, public finance and land use, trends and prospects, and regional policy. The book ends stressing the need for "*continuing analysis of current change.*"

Throughout the whole work, there is uniformly careful concern about facts. Evaluation of statistical data, both from the point of view of source and of definition of categories, is a prominent concern. One set of observations is balanced against another and corrections are applied with logic and a nicety of judgment which shows thorough familiarity with all phases of statistical evaluation. One has first the impression and then the evidence that the whole study was carried out with the utmost care and with full realization of all of the pitfalls that beset the analyst when he is confronted with data of varying reliability.

The book includes 123 tables and 155 "charts."

All graphs and maps are labelled as charts. It is in the maps that *The Rural Economy of New England* is in any way disappointing to the geographer. Adverse criticism must be levelled against the maps. There is a glaring lack of any direct statement of scale on any map and of indirect statement of scale on all except a few. There is a lack of uniformity both in scale and projection of base maps. There is unequal representation on maps which are the subject of direct comparisons in the text. For example, Chart 11, entitled *Distribution of Population in New England and Adjoining Areas, 1930*, uses one dot to represent 100 rural persons while Chart 12, entitled *Farm Population of New England by Towns, 1920*, uses one dot to represent 200. Incidentally, Chart 11 is entirely blank outside New England and therefore bears an erroneous title. There is variety in degree of generalization shown on maps that are compared directly. And there is generally poor draftsmanship on all except a few maps. When so very much care has gone into all other phases of the work as becomes amply evident upon examination of the book, it is to be deplored that any item, especially one so easily controlled as the maps, should be allowed to mar the end product.

Then, too, the geographer wishes that there might have been more realistic representations of distributions than those which can be developed from statistics gathered on the basis of political divisions alone. Field observations and field mapping would have made this possible. It is not conceivable that Mr. Black and his coworkers have no field knowledge of the area. Why, then, is there so little of this type of evidence included among the maps? Corrections and evaluation introduced as the result of field observations are certainly fully as important as corrections applied to statistical data, particularly when the latter are for political divisions. For example, Chart 120, *Net Farm Incomes . . .*, can create false impressions by failing to recognize differences that occur, say, between the farms of the Connecticut Lowland and those of the uplands to either side when both are summarized in a single county figure.

Regardless of weaknesses of the above sort, *The Rural Economy of New England* is a study of exceptionally high quality. It is, first of all, a magnificent contribution to scholarly investigation of New England. It is beyond that a stimulating approach for the wider field of regional planning. Mr. Black is to be both thanked for and congratulated upon his skilful direction and forceful presentation of a long-term group project. Geographers in particular can gain much from a careful examination of the methods employed and the attitudes expressed in *The Rural Economy of New England*.

HENRY MADISON KENDALL

Syracuse University

Economic and Industrial Geography, by A. M. NIELSEN. xxiii and 728 pages; maps, diagrs., tables, bibliogr., index. Pitman Publishing Corporation, New York, Toronto, London, 1950. $6.75. 9¼ x 6¼ inches.

This book is intended to be an elementary text for a full-year course in the principles of economic geography.

Several general approaches are discernible in texts used in economic geography today. These include the subject or topical approach, the regional approach, and the activity approach. *Economic and Industrial Geography* tends to follow the subject or topical approach.

The first chapter discusses the field of economic geography. Professor Nielsen summarizes the nature of economic geography by saying "it is the study of the relationship of earth and man with the emphasis on man." Such a statement certainly is not definitive. It could apply to cultural geography, human geography, or to geography in general, just as well as to economic geography. The author fails to make clear that economic geography investigates the economic structure of human society in terms of its areal arrangement, areal diversity, and areal interrelationships. The general lack of emphasis on areal arrangement, diversity, and interrelationships is not confined to definitions, or to the first chapter. There is not a single map in the whole book designed primarily to show areal variation in economic activity! As a matter of fact there is an almost complete lack of maps of any kind in the book except for eight pages of topographic maps.

Chapters 2 through 11 are devoted to various aspects of the physical environment. Chapters 12 through 20 deal principally with agricultural products and their uses. There are two chapters on mineral resources and industries, one on the fundamentals of manufacturing and site location, and one on trade, transportation, and communication. The final chapter, entitled "Man and Environment," is a summary of the author's views on the interrelationships between man and the earth upon which he lives. Each chapter is followed by sets of review questions and discussion problems. These should be of assistance to students, and perhaps also to the instructor with limited geographic background.

The book contains an inordinate number of inaccuracies, and many gross generalizations of little meaning. In the caption for a photograph (p. 61) reference is made to a "typical V-shaped glacial valley" and to "neve or firn slopes." It is presumed that the author means a typical *U*-shaped glacial valley, and neve or firn slopes. In the caption beneath another photograph (p. 90) the author speaks of accelerated erosion in recent times that has exposed sedimentary and metamorphic rock, and developed a contour pattern in the landscape. It

is perfectly apparent that the contour pattern referred to is the result of terraces produced by Chinese farmers rather than by erosion. On page 63 the map incorrectly portrays the size and location of both Lake Agassiz and Lake Bonneville. In the first paragraph of Chapter 12, in referring to grain consumption in the United States, Professor Nielsen writes, "In order, by quantity of consumption in millions of bushels, (1) rice led with 700.2; (2) wheat, 488; (3) corn, 177; . . ." Any geographer would be surprised to note that more rice was consumed in the United States than wheat or corn. In checking the source used it was found that bushels of wheat were compared with pounds of rice! On page 208 it is stated that holdings of 25,000 to 50,000 acres are not unusual in the eastern part of the spring wheat belt of the United States. Not only are wheat holdings of such size unusual in this region, but as individually operating units, they are essentially non-existent. On page 676, again in referring to the United States, the author says, "the distribution and size of cities and the large amount of manufacturing are based on the size of the country, with the diversity of topography, soil, and climate." The statement makes no contribution and is nearly meaningless.

The inadequate attention given to the various aspects of areal variation in economic activity, the general lack of maps, and the frequency of inaccuracies overshadow what good points this book may possess and seriously limit its value as a basic text.

JOHN H. THOMPSON

Syracuse University

Afrique, Terre qui Meurt, by JEAN-PAUL HARROY. Marcel Hayez, Brussels, 1949 (2d edn.; first published in 1944). x plus 557 pages; 1 map.

Here we have a thoroughgoing study in the field of natural resources—their use and abuse. It does not quite cover its title "Africa," because it omits the Mediterranean face of the continent, but it goes far beyond its subtitle "Dying Land," by tracing the interrelations between land, population density, technology, social institutions, shift in world relations, and mutual lack of understanding. It shows how these complex factors contribute singly and jointly to deterioration in African resources.

The outlook is gloomy, because the use of the land as practiced upsets the balance between man and nature, an equilibrium more delicately poised in Africa than in middle-latitude continents. The facts are sobering, and the author rightly lets them speak for themselves, never preaching either the jeremiad of the plundered planet or the gospel of enough and to spare. The final two sections consider means of ameliorating the present condition, and the steps that have already been taken.

For the businessman concerned with Africa, the book sets the stage, shows the actors, and outlines the drama being enacted. The natural conditions as they vary over the huge continent are clearly presented, along with a working knowledge of the indigenous society of the Africans and specific information as to how the European type of economy and associated culture is affecting both nature and man.

Geographers versed in natural resources of the middle latitudes will learn much from applications of principle here made to the African scene. Even those familiar with the acute resource problems of the tropics can benefit from the neat recapitulation of the African part of the story.

Presumably anthropologists and sociologists will similarly value the sections on native and immigrant cultures. Certainly geographers will find a great store of information about cultural background and institutions interpreted in the light of their interaction—a comprehensive and articulated survey not found elsewhere.

Throughout the several topics into which the book is divided, the African soil remains the theme. The section on principles of soil formation is stated fully in non-technical language. Other aspects of nature receive their due; *e.g.*, the micro-fauna so significant to human occupance of the low latitudes. Minerals receive less attention than they would get in a study of the economic geography of Africa, but the part they play in the dying land is shown.

The author quotes freely from all the languages employed by students of Africa. Since French and English are chief of them, quotations and references in those languages dominate the bibliography and the numerous footnotes. Many of these notes are gems of information that disclose the wide range and deep penetration of the author's studies.

DERWENT WHITTLESEY

Harvard University

Southeast Asia, by E. H. G. DOBBY. 415 pp.; maps, map end-papers, diagrs., bibliogr., index. Univ. of London Press Ltd., London, 1950. 18 shillings. 8½ x 5½ inches.

A puzzling book: at first glance impressive, on careful reading disappointing; looking back one wonders what there was to impress or to disappoint. From this it is clear that the book is uneven, full of useful material, very good in parts, but with something important lacking. This something is Professor Dobby's ability to synthesize clearly his undoubted knowledge.

The actual organization is sound enough: five chapters on the natural landscape, then sixteen of regional description, finally four on the general human geography. Some chapters seem a little thin, others perhaps overloaded with technical detail for a book which sets out "to stimulate the sociologist, the administrator, the politician, and the businessman." This aim is most nearly achieved in the last two chapters, on the economy and the socio-political structure of Southeast Asia; and if all were on this level there would not be a great deal to criticize. Unfortunately, even here we find, along with much sound observation and judgment, some confused thinking.

This indeed is the crux. There are a number of minor faults; it is inadequate, for example, to give a reference by merely attaching an author's name in brackets, and the use in the same sentence (p. 375) of kilowatts and horse power is symptomatic. There is also a certain slackening of grip when Professor Dobby deals with the more northerly areas of his field: the Burmese chapters contain a number of small inaccuracies, such as the Sittang "Delta" (p. 193) or Kalaw as a rail terminal (p. 194). But on the whole these are no more than one might expect in a work of this type, in which immunity from error could be attained only by omniscience. One may also condone the occasional carelessness shown in the usually admirable maps, e.g., the stark incompatability between the section of the Korat plateau and the text (p. 162) and the muddled keys of Figures 27 and 88. Such details, while annoying, are in themselves not sufficient to vitiate the book as a whole. Against them can be set such contributions as the description of Malayan rice-farming (p. 108), or of Siam in general (pp. 261–265), and the discussion of Philippine social problems (pp. 338–344).

It is not detail error but a general looseness of argument which is finally responsible for our disquiet. This is reflected in a style which is not always actually ungrammatical, but which continuously sets one's teeth on edge by inversions, bad mannerisms, and a general barbarous clumsiness. These do not occur just here and there; they pervade the whole, and are surely an indication of how Professor Dobby thinks. This is a comprehensive criticism and must therefore be supported by examples.

On the very first page we have a non sequitur (italics used in this and later quotations are the reviewer's): "The archipelago section merges eastwards into island groups of the West-Central Pacific, *for which reason* New Guinea itself may best be considered outside the definition 'Southeast Asia' "—the legitimate reasons follow. On page 97 "The continental submergence has induced premature precipitation upstream," whatever that may mean. On page 128 "*Because* the development of Malaya into the forms of today has taken place within the last 150 years, it exemplifies geographical factors involved in changing the ecology and associations of life in tropical areas," but so it would if it had taken 1500 years; another non sequitur. On the next page the British posts on Penang and Singapore followed a political directive, which is enterprising for islands other than Swift's Laputa. On page 196 we learn that the East Indies are sufficiently accessible for human beings "to experience the environmental factors at work"; where can't they? On page 315 "Of the large plantation holdings by Frenchmen, nearly two-thirds were under paddy and sublet to tenant farmers," i.e., were therefore not plantations. On page 337 "An uneven distribution of people has developed in the Philippines"; where hasn't it? Finally on page 376 we have so magnificent an example of Professor Dobby's style, an example in which the cult of the non sequitur reaches its height, that it must be quoted *in extenso:* it is after all only one sentence: "*Because* the production of primary agricultural commodities like rubber, copra, medicinal plants, and tapioca, all the basis of industrial processes elsewhere, has been *the* function of Southeast Asia over the first third of this century, culminating in an immediate prewar export valued at nearly $1,000 million per annum, processing and manufacturing of these commodities may *cease* to be done overseas and become the basis of industrialisation within Southeast Asia to make use of local power resources and of the margin of time available among rural populations."

By stern travail one can generally make out the meaning, and perhaps none of these infelicities—those cited are a selection only—is very damning in isolation. But cumulatively they provide evidence of thinking which, when it attempts to rise above the jejune, often (not always) becomes inextricably entangled in verbosity.

This may seem a harsh judgment on a book which undoubtedly shows wide reading and contains much of value; it will be widely used, and not only because it is the only single volume in English covering its field. But the critical tone of this review is a reflection of the reviewer's feeling that here is a real opportunity missed for lack of care and of clear solid thinking. We are given the materials for a really first-class survey of an important and complex area, and we may sort them out for ourselves and recast them into reasonable shape. But that is precisely what Professor Dobby should have done for us; and gratitude for the admirable collection of facts and detached good observations with which he has presented us must, unfortunately, be tempered by regret for the slipshod manner of the presentation.

O. H. K. SPATE

Australian National University

A Geography of Europe, by JEAN GOTTMANN. ix and 688 pp.; maps, ills., bibliogr., index. Henry Holt and Company, New York, 1950. $5.00. 9½ x 6½ inches.

This is the first post-World War II text in English on the geography of Europe, a fact which alone makes it worthy of consideration. Professor Gottmann has been connected with the University of Paris, Princeton University Institute for Advanced Study, and the United Nations Department of Social Affairs, and has written a multitude of monographs and papers on geographical subjects; he should make an ideal author for a text such as this.

The volume includes a study of all the countries of Europe, including that part of the Soviet Union west of the Urals. Allocation of space to various areas is judiciously made, with least emphasis on southeastern Europe. The author emphasizes historical, cultural, social, and economic factors as much as the physical geographical elements in his interpretation of the regions of Europe as it emerges from the postwar crises. The book is organized on the basis of state areas, but the usefulness of the volume is enhanced by analyses of "super-regions": Western Europe, Mediterranean Europe, and Eastern Europe. There is also a preliminary examination of "the general features of Europe" in Part I. As could be expected, there might be some objections to the regional organization, but the author anticipates them tolerantly. The book is well printed, its format is a pleasing one, and the numerous pictures are excellent. By far most of the maps have been taken from the *Geographical Review* and retain their original excellence.

The genuinely and thoroughly postwar approach is, of course, a distinct advantage which the book enjoys over the several prewar texts. Belgium, Holland, and Luxembourg, for example, are treated in one chapter entitled "The Benelux Countries," which closes with a brief discussion of "Will Benelux Work?" Effects of the Cold War, the Iron Curtain, and the occupation of Germany and Austria are consistently recognized, as are the results of Marshall Plan Aid. Professor Gottmann's free flowing prose is generally engaging and is a distinct departure from that of the usual text; students like its readability.

However, the book suffers from a number of weaknesses, most of which seem to arise from an apparent hastiness in preparation of the volume. The worst result of the apparent haste is not simply more than the usual number of errors and inaccuracies but a kind of factual nebulosity in parts of the book. For example, many of the regions are only vaguely defined, although the text is avowedly an analysis of the regions of Europe. A number of points are talked around rather than about. Geomorphic descriptions are surprisingly blurred, perhaps as a result of the deliberate attempt to avoid "technical terminology." Only a few maps were specifically drawn for this volume, and although the *Geographical Review* maps are superb, many are quite out of date and seem in most cases to have been chosen more for their availability than for their pertinence. On the other hand, numerous paragraphs of textual material could have been better presented cartographically. Although the lack of any graphs and tables may not be serious *per se*, this lack contributes to the frequent sparseness of specific information. Moreover, a considerable amount of geography is sacrificed to other factors and to attempts to avoid geographic determinism. Much of the basic material is admittedly taken from the various tomes of the *Geographie Universelle*, but the excellence of the presentation of the source material is largely lost in this briefer form.

Professor Gottmann has undertaken a difficult project and has handled the more troublesome aspects well. Some judicious editing and careful revision would make the volume of much greater usefulness than it is in its present form. Nevertheless, it will undoubtedly be widely adopted for class use because of its up-to-dateness, attractiveness, and readability.

COLBERT C. HELD

University of Nebraska

The Anatomy of Eleven Towns in Michoacán by DAN STANISLAWSKI. 77 pp.; maps, ills., bibliog. The University of Texas Institute of Latin-American Studies, Latin American Studies, X. The University of Texas Press, Austin, 1950. 7 x 10 inches.

Professor Stanislawski here presents a method in urban geography that might well be considered by other students of the field. The method is "anatomical dissection," by means of which the author sets out to determine the "personality differences" of a selected number of small towns in various geographical regions of Michoacán, Mexico. The "anatomy" of a town, according to Stanislawski, consists chiefly of the functional aspects of buildings and the arrangement of the various functions in relation to the central square, or plaza, and to the main arterials. The street plan, architecture, and quality of buildings are given secondary importance. Town plans showing the distribution of functions accompany the text.

The author concludes that the personality of a town, as expressed by the arrangement of functions, has little relation to the geographic region in which it is located; rather, he thinks that the personality is based mainly on the cultural background of the dominant group that developed the town. Thus, the Hispanic town is characterized by the grouping of stores, inns for mule-drivers, leather crafts, and the best

homes in prestige positions, that is, around or near the plaza and along arterials. This arrangement is an indication of the importance of trade as well as the high social rank of merchants in colonial Hispanic culture. In an Indian town, on the other hand, the crafts are numerous and are scattered without regard to prestige location; the plaza is unimportant, and the features associated with mule-driving are absent. Moreover, in the Indian town dwellings are spaced widely in contrast with the tight agglomeration of an Hispanic town. A third type, the dual-character town, which shows characteristics of both the Hispanic and the Indian, is noted in the Michoacán area.

In his study Stanislawski has emphasized the importance of cultural characteristics that are often overlooked in urban analyses. It would be interesting to apply his method to the study of towns of other cultures. Although the peculiar arrangement of functions comprises an important part of a town's personality, other more obvious criteria, such as architecture and street plan, perhaps are equally significant.

ROBERT C. WEST
Louisiana State University

The Middle East: A Physical, Social, and Regional Geography, by W. B. FISHER. xiii and 514 pp.; maps, diagrs., bibliogr., index. (Dutton Advanced Geographies.) E. P. Dutton & Co., Inc., New York, 1950. $5.75. 8¾ x 5½ inches.

There has long been the need for a geography of the Middle East in the English language. For this very reason those who are vitally interested in the Middle East and in Middle Eastern affairs, will open a book of this kind with a certain amount of trepidation; a fear that the author may disappoint them. Happily, Dr. Fisher does not do this. His book is well written, interestingly written, and, for its length, does more than an adequate job on its subject matter.

An introductory chapter deals with the regional concept of the Middle East, its geographical complexity, its importance in world affairs, and its present social status: in short, a brief orientation to the area.

The major part of the text is divided into three sections: Physical Geography; Social Geography; and Regional Geography. The first two consider the Middle East as a whole, the last, as the title implies, is a regional breakdown of the area.

The three chapters of Part I deal with landforms and structure; climate; and soils and natural vegetation. This is the shortest section of the book, but one of especial interest since the author has presented new material on weather and soil conditions, that gives one a better and more delineative conception of these features than has been available previously.

Part II consists of eight chapters. These give the cultural background so necessary to an understanding of the Middle East. In the opinion of the reviewer, this is the best conceived and most effectively executed section of the book. Dr. Fisher has presented, in highly readable form, a review of the ethnic, historical, political and economic forces that have been so important and vital in the shaping of the Middle East. He shows a very real understanding of the people and their problems, and has fortunately maintained, at the same time, an objectivity that is rare among writers on Middle Eastern subjects. This section might well be considered as required reading, not only for all geographers, but for laymen as well.

Part III, the Regional Geography, is the least well done and the most disappointing. The disappointment arises, quite possibly, from what is not contained in the section, rather than from what is. In the space allotted to the regional subdivision, 235 pages, there might well have been presented a more complete regional picture with less emphasis on geology and physiography, and more on culture. There is relatively little attempt at a balanced synthesis of regional features. Although physical features are treated regionally, cultural features are considered systematically and often these do not seem to be in proper balance. Although agriculture, pastoral activities, manufacturing, and mining are treated rather fully, road systems, urban centers, and population patterns, among others, are given rather short shrift.

In the regional subdivision of the Middle East, Dr. Fisher considers Iran and Turkey as political units, while the rest of the area is broken into geographical units, viz., Tigris-Euphrates Lowlands, the Coastlands of the Levant, the Arabian Peninsula, and the Nile Valley and its Borderlands. Why the distinction? Could not Iran and Turkey together be considered a geographical region with equal right?

In some respects the timing of this book is unfortunate. Written prior to, but published well after the creation of Israel, this new state has no place in the text. There are also a few other events of importance that are not included, though last minute revisions might have included them.

There are also a number of rather odd errors or omissions throughout the text. The major one is an almost complete lack of source reference for statistics quoted. Considering the fact that most statistics for the Middle East are only approximations, it would be very helpful to know whom the author was quoting. Second in importance is the lack of any photographs in the text. There are a large number of maps and diagrams but many of them are rather crudely done and there are some actual errors such as the location of Cairo on the map, p. 453, and Ismailia on the map, p. 477. Further examples of text errors are found in the exclusion of the

Yemen from the Arab League; the transposition of location of the Qizil Uzum and the Safid Rud; the omission of Dhahran as a major air base; the statement that dysentery affects mainly the foreign rather than the indigenous population; the entire omission of venereal disease from the discussion of diseases that affect adversely the population of the Middle East.

Anyone writing on the geography of the Middle East is faced with considerable difficulties because of the lack of definite information. Figures for population, crop production, minerals, etc., are at best only approximate. Maps of the areas contain many errors and inaccuracies. Dr. Fisher, in light of these difficulties, has done a very commendable job. His book gives a better picture than any other available in English, and as a college text it is much more than adequate.

The text also contains three appendices—geologic history, temperature distribution in the atmosphere—and a glossary of geographic terms.

JOHN R. RANDALL

The Ohio State University

Metropolitan Atlanta, A Factual Inventory: A Report Containing Texts and Maps on Georgia's Capital City. 40 pp.; maps. The Metropolitan Planning Commission, Atlanta, Georgia, October 1950. 8½ x 11 inches.

Acting on its stated belief that "in America, planning *is* the people" the Atlanta Metropolitan Planning Commission has prepared this concise factual inventory specifically for the citizens of the urban area. It is the Commission's first report after completing its initial or fact-finding stage of operations in the summer of 1950. The purpose of the report has not been to present detailed facts and analyses or to argue before specialists a complex planning program. Instead, it has sought to present to the people those basic facts about the present community needed to make them aware of the problems facing the city. For an urban community so politically fragmented as the Atlanta metropolitan area, it is just such an awareness and understanding on the part of the peoples involved that is prerequisite to success in civic planning. The Atlanta commission approached the problem of planning realistically in acting on the premise that its second stage, that of program making, and its third stage, that of effectuation, depend eventually upon the degree to which it enlists the ideas, wishes, and support of the voting citizenry.

This booklet seems singularly effective for that purpose. It should attract attention amongst those interested in the practical aspects of urban planning as a fine example of a sincere report directed primarily at the average citizen. Competing for his time and interest, it is brief and attractive, urgent and thought provoking without being alarming. Although comprehensive in scope, the range of background and current information is presented in only twenty-two topics, each completed on a single page. Of special interest is the fact that almost every topic is accompanied by a pertinent map, usually on the facing page. By this method of presentation the less interested citizen is presented the minimum essentials in the textual materials while the more interested and professional reader is able to extract a wealth of additional information and details from the maps. It will probably be for its array and use of maps that this account will attract interest far beyond the limits of Atlanta itself. In view of the purpose of the report, the few gaps and shortcomings in the materials are not serious.

By necessity, this report is, in its first function, a primer for adults on the subject of urban planning and should be judged on that basis. In its introduction it very simply and ably presents the needs for and problems in planning for a complex and politically heterogeneous urban community. Next, to give historical background and spatial perspective, the report briefly acquaints the reader with the city's geographic and organizational situation in the southeastern United States. On a local scale, it outlines the unique topographical situation and, with maps, presents effectively the functional and political structure of the urbanized area. Most of the report thereafter deals with a variety of specific conditions and the more urgent problems. These include the spatial, such as land-use and zoning; the technical, such as highways and water supply; and the social, such as population trends, race, health, and housing. There is no summary; but there hardly needs be any. The report should give the reader addressed, in this case the citizen, an understanding of his city—a knowledge surprisingly rare among city peoples—and it should make him think more seriously about the question of planning. He should be well aware that any summary and conclusion must eventually come from himself and his neighbors. The successful inculcation of this attitude is the singular value of the Atlanta Planning Commission's first report.

RAYMOND W. STANLEY

University of California at Los Angeles

A World Statistical Survey of Commercial Production: A Geographic Sourcebook, by JOHN C. WEAVER and FRED E. LUKERMAN. v and 146 pp.; tables, bibliogr., outline maps. Burgess Publishing Company, Minneapolis, 1950. $4.00 10¾ x 8½ inches.

The authors of this manual draw together in utilitarian form for the "many persons in academic and commercial circles . . . a sourcebook of information for the use of college stu-

dents in courses dealing with commercial aspects of geography." The product is a sourcebook in summary form which can be used to supplement a teaching manual for a systematic course in economic geography. The book comprises 144 pages of tabular data, one and one-half pages of bibliography, and provides in end pockets thirteen continental and strategic area outline maps, three of which are duplicates. The tabular data divide into population and land resources, sources of power, metallic and non-metallic minerals, forests and fisheries, agricultural crops, and livestock. The results are useful, even handy. One feature is especially valuable for the teacher of geography at the introductory level, namely, the statistical attempt to give for the countries of the world the acreage and the per cent of the world's total in arable land, permanent pasture, forest and woodlands, unused but potentially productive, and built-on and wasteland.

One must give pause that these authors, undoubtedly with a staff limited to themselves and at most a few student assistants, even undertook this compilation. The standard reference sources which they tapped are unquestionably the best available, but the pitfalls of sheer copying alone are considerable; whereas questions of classification, comparability, and variables in the reliability of the data pertaining to such areas as China, underdeveloped areas of Africa, and various tropical countries of Latin America are formidable. Therefore, one must conclude that this guide is of utility, but at a limited and elementary level. As for the maps provided with this manual, they do lend it a geographic aspect. Obviously they are meant to serve for student exercises utilizing the data contained in the manual, as are the several sheets of graph paper, but in this connection no guidance is given. Furthermore, since commercial as well as academic circles were to be served, a world political finder map might have been included. Yet, in spite of some of these reservations, which probably would apply to any summary statistical manual the data of which were once removed from their primary census and other governmental sources, this is a useful teaching aid in economic geography.

MALCOLM J. PROUDFOOT

Northwestern University

NEW EDITIONS

Africa: A Social, Economic and Political Geography of Its Major Regions, by WALTER FITZGERALD. 6th edit., revised. xv and 499 pp.; maps, lists of references, index. (Dutton Advanced Geographies.) E. P. Dutton & Co., Inc., New York, 1949. $6.75. 8½ x 5½ inches.

Economic Mineral Deposits, by ALAN M. BATEMAN. 2d edit. xi and 916 pp.; maps, diagrs., ills., lists of references, index. John Wiley & Sons, Inc., New York (Chapman & Hall, Ltd., London). 1950. $7.50. 9¼ x 6 inches.

Europe: A Regional Geography, by M. R. SHACKLETON. 4th edit. xvi and 525 pp.; maps, ills., lists of references, index. Longmans, Green and Co., Inc., London, New York, Toronto, 1950. $4.25. 8¾ x 5½ inches.

France: A Regional and Economic Geography, by H. ORMSBY. 2d edit., revised. xiv and 525 pp.; maps, diagrs., bibliogr., index. (Dutton Advanced Geographies.) Methuen & Co., Inc., London, E. P. Dutton & Co., Inc., New York, 1950. $5.50. 8½ x 5½ inches.

Fundamentals of Economic Geography, by NELS A. BENGTSON AND WILLIAM VAN ROYEN. 3d edit. Ada Espenshade and Peveril Meigs, Collaborators. xxviii and 574 pp.; maps, diagrs., ills., lists of references, index. Prentice-Hall, Inc., New York, 1950. $5.75. 9¾ x 7 inches.

Latin America, by PRESTON E. JAMES. Revised edit. xvi and 848 pp.; maps, ills., bibliogr., index. Odyssey Press, New York, 1950. $6.00. 9¼ x 6¼ inches.

North America: An Historical, Economic and Regional Geography, by LL. RODWELL JONES AND P. W. BRYAN. 9th edit., revised. xvi and 582 pp.; maps, diagrs., index. (Dutton Advanced Geographies.) Methuen & Co., Inc., London, E. P. Dutton & Co., Inc., New York, 1950. $5.50. 8½ x 5½ inches.

South America: An Economic and Regional Geography with an Historical Chapter, by E. W. SHANAHAN. 7th edit., revised. xiv and 318 pp.; maps, diagrs., bibliogr., index. (Dutton Advanced Geographies.) E. P. Dutton & Co., Inc., New York, 1949. $5.50. 9 x 5½ inches.

World: A General Geography, by L. DUDLEY STAMP. 12th edit., revised and reset. 669 pp.; maps, diagrs., ills., index. Longmans, Green and Co., Inc., London, New York, Toronto, 1950. $2.25. 7½ x 5 inches.